INTRODUCTION

Acute severe ulcerative colitis (ASUC) as defined by Truelove and Witts criteria is a medical emergency requiring hospitalization and time bound management. ASUC complicates the course of ulcerative colitis (UC) in up to 25% of cases with a third of these episodes being the presentation of UC. Intravenous (IV) steroids remain first-line therapy for ASUC, but only 60% patients respond to IV steroids, with the rest requiring rescue in the form of advanced immunosuppression (infliximab or ciclosporin) or surgery. It is clinically highly relevant to predict steroid nonresponse in order to identify patients who need a change in treatment strategy to improve outcomes, both in the short and medium term. Baseline endoscopic severity, stool frequency, C-reactive protein (CRP) at
day 3 and fecal calprotectin (FCP) at day 3 have been correlate
d with short-term outcomes in ASUC during the index ad
mission.⁴⁻⁷ Our previous study described the All India Institute
of Medical Sciences (AIIMS)’ index (a prediction score com
prising–baseline ulcerative colitis endoscopic index of severity
[UCEIS] > 6/8 and day 3 FCP > 1,000 μg/g) and its high posi
tive predictive value (100%) in predicting steroid nonresponse
in patients with ASUC.⁶ Apart from predicting nonresponse to
steroids, the index provides a way of determining the impact
of external factors on short-term outcome, including cyto
glovirus (CMV) infection.

CMV being reported in colonic tissue in 33%–36% of steroid
refractory colitis has been postulated as one of the reasons for
flare of UC.⁸ However it is still not clear whether CMV primari
ly worsens the inflammation in patients with severe UC or is a
secondary phenomenon, and merely a marker of severe dis
ease.⁹⁻¹¹ CMV infection is conventionally diagnosed by pres
ence of inclusion bodies on histopathological examination
and immunohistochemistry (IHC) against CMV antigen, but
these methods are time consuming and results are usually not
available at day 3 of IV corticosteroid therapy when decision
for stepping up immunosuppression is required. Quantitative
CMV polymerase chain reaction (PCR) in mucosal tissue has
a rapid turnaround time and can be used to identify CMV in
fection in ASUC. It has also been found to predict CMV IHC
positivity.¹²⁻¹⁵ However, the significance of CMV mucosal PCR
and high viral load on the outcomes in ASUC is still debatable.
Moreover, whether CMV adds to the predictive value of exist
ing severity indices, remains unknown. The present study was
therefore designed to evaluate the role of quantitative mucosal
CMV PCR as a predictor of outcomes in patients with ASUC
and to find out whether it adds to previously defined predi
tors of short-term outcomes.

METHODS

1. Patients
All patients with ASUC defined by Truelove and Witts criteria
(6 or more stools with blood and 1 or more of following he
molobin < 10.5 g/dL, erythrocyte sedimentation rate > 30
mm/hr, fever > 37.8°C, or tachycardia > 90/min) who were
hospitalized at AIIMS, New Delhi from May 2016 to July 2019
were screened for inclusion.¹⁶,¹⁷ Secondary referrals, children
< 18 years and patients who had detectable Clostridioides dif
cicile toxin were excluded.

2. Ethical Considerations
The study was approved by Institute Review Board of AIIMS
(IRB No. IESC/T-277) and all patients gave written informed
consent.

3. Definitions
1) Ulcerative Colitis
Diagnosis of UC was based on clinical, radiologic and histo
logical criteria.¹⁸ Patients with index presentation of ASUC
that later turned out to be infection or Crohn’s colitis were ex
cluded.

2) Steroid-Failure
Patients of ASUC who required rescue medical therapy (IV
cyclosporine 2 mg/kg for up to 7 days, oral tacrolimus 0.1–0.2
mg/kg or infliximab 5 mg/kg) or surgery during index hospi
talization were defined as steroid failure patients.

3) Disease Extent
Disease extent was defined as maximum macroscopic extent
at colonoscopy preceding ASUC according to Montreal classi
fication.¹⁹ For patients presenting with ASUC at diagnosis, ex	ent was determined from the first colonoscopy after discharge
or the surgical specimen if they underwent colectomy.

4) Prior Steroid Use
It is defined as any use of systemic steroids prior to the epi
dode of ASUC. Steroid use in first year of diagnosis: it included
patients who received steroids of any form (oral or IV) in their
first year after diagnosis.

5) Ulcerative Colitis Endoscopic Index of Severity
The endoscopic disease severity was assessed with UCEIS
which the sum of 3 descriptors: vascular pattern (scored 0–2);
bleeding (scored 0–3); erosions and ulcers (scored 0–3), range
0–8, assessed in the most severely affected area at flexible sig
moidoscopy.²⁰

6) AIIMS’ Index
It is a simple predictive score based on 2 objective parameters:
(1) UCEIS assessed on the day of admission and (2) FCP mea
sured on day 3 of IV steroid. It is calculated with the following
formula: baseline UCEIS > 6+day 3 FCP > 1,000 μg/g (where
FCP > 1,000 μg/g = 1 and UCEIS > 6 = 1; and FCP ≤ 1,000 μg/g
= 0 and UCEIS ≤ 6 = 0). The score ranged from 0 to 2. Patients
who fulfilled both the criteria (score = 2) are considered
7) **Short-Term Outcome**

It was defined as outcome during index admission (steroid failure as defined above).

8) **CMV IHC**

Sections cut from colonic biopsy blocks were subjected to the mouse monoclonal antibody against CMV stain (Clone CCH2+DDG9; dilution 1:100, DAKO, Glostrup, Denmark). Endogenous peroxidase was blocked using 4% hydrogen peroxide, followed by antigen retrieval by boiling in citrate buffer. Standard overnight staining protocol was followed. The reaction product was developed with 3,3’-diaminobenzidine and counterstained with hematoxylin. Appropriate positive and negative controls were used. IHC stain was taken as positive when strong inclusion like positivity was noted in the tissue sections.

9) **Quantitative CMV PCR**

Quantitation of CMV DNA was performed on colonic mucosal samples by real-time PCR. DNA for real-time PCR assay was extracted from mucosal samples by using the DNAeasy Blood and tissue kit (Qiagen, cat no- 69506, Hilden, Germany) as per the manufacturer’s instructions. The CMV DNA load was expressed as CMV DNA copies per milligram of mucosal tissue biopsy. The oligonucleotide primers used for quantitative CMV-DNA determination were derived from a highly conserved AD-1 region of glycoprotein B (gB) gene. Human genomic sequence glyceraldehyde-3-phosphate dehydrogenase (GAPDH) gene was used as an internal control for the quantitative real-time PCR assay as described previously. For quantification, a plasmid DNA containing the target sequence of gB gene was used as an internal control for the quantitative real-time PCR assay as described previously. For quantification, a plasmid DNA containing the target sequence of gB gene was used as an internal control for the quantitative real-time PCR assay as described previously.

6) **Statistical Analysis**

Continuous variables are expressed as the mean ± standard deviation and non-Gaussian distribution as median and range. Categorical variables are summarized as frequencies with percentages. To avoid decimal points, percentages were rounded up. Quantitative variables on admission were compared using Student t-test or Mann-Whitney U test and qualitative variables by chi-square test. Comparison of the means of continuous variables for 2 groups was based on analysis of variance or the nonparametric Kruskal-Wallis test, where indicated. Receiver operator characteristic curves were used to identify cutoff with optimal sensitivity and specificity. Clinical observations of pulse rate, temperature, blood pressure, stool frequency and laboratory parameters during the hospital stay were recorded. Serum CRP and FCP performed on day 3 of IV steroid therapy and fecal samples were taken on admission for culture, C. difficile toxin assay by ELISA (enzyme-linked immunosorbent assay). Day of admission was counted as day 1.

The outcome measure was failure to respond to IV steroid therapy as defined above.

5. **Management**

All patients received IV and rectal hydrocortisone (400 mg/day IV, 200 mg/day per rectum), whilst continuing 5-ASA (5-aminosalicylic acid) therapy, according to guidelines, as well as antibiotics (ciprofloxacin and metronidazole), given the prevalence of gastrointestinal infection in India. Blood transfusion was given as required (hemoglobin < 80 g/L). Oxford criteria were used to identify patients at high risk of colectomy and if unresponsive to 5–7 days of IV steroids, rescue therapy or colectomy was advised. The option of medical therapy with infliximab/cyclosporine versus surgery was given upfront to the patients (at day 5–7), and the decision was made after joint medical-surgical review and patient counseling (given the prohibitive cost of these therapies in the developing world many patients opted for surgery before any rescue therapy). Patients responding to IV steroids were discharged on 40 mg/day prednisolone with a taper period of 3 to 4 months, along with azathioprine.

4. **Study Design**

It was a prospective observational cohort study. Patients’ details were collected on baseline demographics, prior therapy for UC, endoscopic assessment of severity (UCEIS) by unprepared flexible sigmoidoscopy within 24 hours of admission and biopsies taken in saline and formalin for quantitative CMV PCR and CMV IHC respectively. Clinical observations of pulse rate, temperature, blood pressure, stool frequency and laboratory parameters during the hospital stay were recorded. Serum CRP and FCP performed on day 3 of IV steroid therapy and fecal samples were taken on admission for culture, C. difficile toxin assay by ELISA (enzyme-linked immunosorbent assay). Day of admission was counted as day 1.

The outcome measure was failure to respond to IV steroid therapy as defined above.
RESULTS

1. Patients

Eighty-seven patients with ASUC were hospitalized during the study period; 11 patients were excluded (Fig. 1), and 76 were finally included in the study. Forty-six patients (61%) responded to IV steroid and 30 patients (39%) had steroid failure. Of these, 20 patients received rescue medical therapy (6 ciclosporin, 1 tacrolimus, and 13 infliximab) and 12 (16%) required surgery, including 2 patients after failure of rescue infliximab therapy.

2. Baseline Demographic and Clinical Characteristics

Mean age at admission was 35.5 ± 12.1 years, with 53% males and 8% patients presented with ASUC at diagnosis (see Table 1 for demographics). Patients in the steroid failure group had a higher frequency of steroid use in the first year of diagnosis compared to steroid responders (though not statistically significant) (22/30 [73%] vs. 27/46 [59%]; P = 0.15). There was no difference between the 2 groups with respect to age of presentation, sex, extent and duration of disease, presence of extraintestinal manifestation, prior ASUC, prior use of azathioprine and systemic steroids (Table 1).

Table 1. Baseline Demographics and Disease Phenotypes of Patients of ASUC and Comparison of Steroid Responders with Steroid Failures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total patients (n = 76)</th>
<th>Steroid responder (n = 46)</th>
<th>Steroid failure (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>35.5 ± 12.1</td>
<td>34.2 ± 10.0</td>
<td>37.4 ± 12.2</td>
<td>0.91</td>
</tr>
<tr>
<td>Male sex</td>
<td>40 (53)</td>
<td>23 (50)</td>
<td>17 (56)</td>
<td>0.42</td>
</tr>
<tr>
<td>Duration of UC prior to ASC (mon)</td>
<td>12 (1–180)</td>
<td>12 (1–180)</td>
<td>18 (6–120)</td>
<td>0.51</td>
</tr>
<tr>
<td>Index presentation of UC as ASC</td>
<td>6 (8)</td>
<td>4 (9)</td>
<td>2 (7)</td>
<td>0.53</td>
</tr>
<tr>
<td>Extent</td>
<td></td>
<td></td>
<td></td>
<td>0.92</td>
</tr>
<tr>
<td>E2 (left-sided colitis)</td>
<td>20 (26)</td>
<td>12 (26)</td>
<td>8 (27)</td>
<td></td>
</tr>
<tr>
<td>E3 (extensive colitis)</td>
<td>56 (74)</td>
<td>34 (74)</td>
<td>22 (73)</td>
<td></td>
</tr>
<tr>
<td>Prior azathioprine use</td>
<td>34 (45)</td>
<td>21 (46)</td>
<td>13 (43)</td>
<td>0.51</td>
</tr>
<tr>
<td>Previous ASUC</td>
<td>18 (24)</td>
<td>9 (20)</td>
<td>9 (30)</td>
<td>0.73</td>
</tr>
<tr>
<td>Prior systemic steroid use</td>
<td>60 (79)</td>
<td>35 (76)</td>
<td>25 (83)</td>
<td>0.61</td>
</tr>
<tr>
<td>Steroid use in 1st year of diagnosis of UC</td>
<td>49 (64)</td>
<td>27 (59)</td>
<td>22 (73)</td>
<td>0.15</td>
</tr>
<tr>
<td>Tobacco user</td>
<td>14 (18)</td>
<td>8 (17)</td>
<td>6 (20)</td>
<td>0.42</td>
</tr>
<tr>
<td>Presence of EIMs</td>
<td>27 (35)</td>
<td>16 (35)</td>
<td>11 (37)</td>
<td>0.91</td>
</tr>
<tr>
<td>13 Central or peripheral arthralgia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Episcleritis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Primary sclerosing cholangitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Central or peripheral arthralgia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Episcleritis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Pyoderma gangrenosum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are presented as mean ± standard deviation, number (%), or median (range).

ASUC, acute severe ulcerative colitis; UC, ulcerative colitis; ASC, acute severe colitis; EIMs, extraintestinal manifestations.
Clinical and Laboratory Parameters during Hospitalization

Median stool frequency on the day of presentation was 10 (6–20) which decreased to 7 (2–12) on day 3 of IV corticosteroids (Table 2). Patients needing rescue therapy and/or colectomy had a higher stool frequency on day of admission (11 [9–18] vs. 9 [6–20]; \(P = 0.01\)) and day 3 of IV corticosteroids (7 [4–14] vs. 5 [2–15]; \(P = 0.06\)). Patients with steroid failure also had higher baseline UCEIS on sigmoidoscopy (6 [4–8] vs. 5 [3–7]; \(P = 0.04\)) and higher FCP level on day 3 of IV steroid (1,383.8 \(\mu g/g\) [330.0–7,427.0] vs. 747.0 \(\mu g/g\) [44.2–4,062.0]; \(P < 0.01\)). Fourteen (47%) patients in the steroid failure group were positive for both the criteria of AIIMS’ index (AIIMS’ index = 2) compared to only 1 patient (2%) in steroid responder group (\(P < 0.01\)). Forty-five patients (59%) had positive CMV DNA PCR on mucosal biopsy. Patients with steroid failure had a significantly higher mucosal CMV DNA load as compared to steroid responders (3,454 copies/mg [0–2,700,000] vs. 116 copies/mg [0–27,220]; \(P = 0.004\)). CMV IHC on biopsy specimen was positive in 12 patients (16%) (Table 2). Only 1 patient had an inclusion body detected on histopathological examination. Patients received IV steroids for a median 5 days (range, 5–10 days) with duration of hospital stay being 11 days (range, 5–36 days). Two patients developed toxic megacolon, both underwent colectomy. One patient who was operated on 9th day of hospital admission without any rescue medical therapy, died on postoperative day 3 from ventricular arrhythmia due to hypokalemia.

CMV DNA Load as Predictor of Steroid-Response

Positive IHC for CMV in biopsy or mere CMV PCR positivity were not significantly different between steroid responders.
and failures (13% vs. 20%, $P = 0.41$ and 52% vs. 70%, $P = 0.15$; respectively). However, patients with steroid failure had a significantly higher mucosal CMV DNA load as compared to steroid responders (Table 2). The cutoff value for quantitative CMV DNA load to predict steroid-failure was derived from a receiver operating characteristic curve. Mucosal CMV DNA $>2,000$ copies/mg on admission could discriminate between steroid-failures and responders with a sensitivity of 53%, specificity 90% and area under the curve of 74% (95% confidence interval [CI], 61–87) (Fig. 2).

5. Multivariable Analysis
On univariate analysis baseline UCEIS, day 3 stool frequency, day 3 FCP, patients fulfilling AIIMS’ index, and quantitative CMV DNA $>2,000$ copies/mg met the criteria for multivariable analysis between steroid-failures and responders. However due to collinearity between baseline UCEIS, day 3 FCP and AIIMS’ index, only day 3 stool frequency, AIIMS’ index and CMV DNA $>2,000$ copies/mg were entered into multivariable model. On multivariable analysis, only CMV DNA quantitative $>2,000$ copies/mg (odds ratio [OR], 10.2; 95% CI, 2.6–39.7; $P < 0.01$) and AIIMS’ index (a score of 2) (OR, 39.8; 95% CI, 4.4–364.4; $P < 0.01$) remained significantly associated with steroid-failure (Table 3).

Quantitative CMV PCR $>2,000$ copies/mg and AIIMS index were also found to be the only significant predictors of colectomy at index admission (Supplementary Table 1).

6. CMV PCR and AIIMS Index for Predicting Steroid Response
AIIMS’ index had very high specificity for predicting steroid failure in patients with ASUC but had a sensitivity of only 47% (Table 4). But using mucosal CMV DNA load along with AIIMS’ index (mucosal CMV DNA load $>2,000$ copies/mg or AIIMS’ index positive) markedly increased the sensitivity (80%) to predict steroid failure (Table 4). That way we could...
Intest Res, Published online www.irjournal.org

The optimum outcome on rescue therapy requires predicting nonresponse to steroids in a time bound manner, which has led to development of several predictive scores utilizing stool frequency, CRP, FCP and endoscopic severity. Fulminant episodes in the disease course of UC can also be precipitated by viral, bacterial or parasitic superinfections, and could also be responsible for nonresponse to IV steroids in addition to disease related factors.

Present study explored this concept and showed that high mucosal CMV DNA load in these patients is a major predictor for nonresponse to IV steroid and need for colectomy. Thirty (39%) patients in the present study had steroid failure. 12 (16%) underwent colectomy and 20 (26%) received rescue medical therapy. Two patients underwent colectomy after failure of rescue infliximab therapy. The diversity of choice of rescue therapy was mainly based on patients’ preference or financial constraints.

Depending upon diagnostic tests, CMV positivity in the present cohort varied from 16% based on tissue IHC to 59% as detected in CMV PCR. Only 1 patient had presence of inclusion body in the biopsy. The prevalence of CMV infection in patients with steroid refractory UC varies across series, and has been reported to be similar to other patients, or significantly higher than steroid responsive group.

The positivity rates vary depending upon the method of detection. Although it is not well established, most experts agree upon histology/IHC as the most specific tests for detection of colonic CMV infection. However these are limited by poor sensitivity and delay in diagnosis, which requires a test with better sensitivity and rapid turnaround time to evaluate the significance of CMV positivity on the outcomes in ASUC. In this regard, CMV mucosal quantitative PCR is an objective quantitative method for detection of CMV in the tissue with results being available within 24 hours. In the present study, quantitative CMV PCR could detect CMV in 59.2% of patients with ASUC, which was significantly higher than that by IHC (15.7%) only. Similar to the present study, in a study by Yoshino et al., among 30 patients with steroid refractory acute severe colitis, quantitative PCR for CMV DNA in mucosal biopsy was positive in 17 patients, of which only 4 were positive for IHC, highlighting the limited sensitivity of IHC as compared to quantitative CMV PCR. Of those 17 CMV-DNA-positive patients, 10 patients were successfully treated with ganciclovir and 12 of the 13 CMV-DNA-negative patients (92.3%) achieved remission after intensifying their immunosuppressive therapies.

Previous studies have reported conflicting results regarding the value of mucosal CMV PCR as a predictor of outcomes in

Fig. 3. Prediction of steroid response in acute severe ulcerative colitis (ASUC) patients using All India Institute of Medical Sciences index and high mucosal cytomegalovirus DNA load (>2,000 copies/mg).
patients with ASUC. In a recent pediatric study of 56 patients with ASUC, 27% were CMV positive of which 93% were ster-
roid refractory and 20% required colectomy during hospital-
ization, and additional one-third required over next 1 year, 
highlighting the influence of CMV on short- and long-term outcomes in ASUC.28 Similarly, in 2 other studies of 95 (33
CMV IHC positive) and 149 patients (50 CMV positive on 
IHC/histopathology examination), the colectomy rates and need for rescue therapy was significantly higher in CMV posi-
tive patients.311 However, in a case-control study of hospital-
ized UC patients, though the hospital stay was longer in those 
with concomitant CMV infection (n = 145) than non-CMV group (n = 14,690), the colectomy rates and mortality were similar.10 Prevalence of CMV has also been correlated with se-
verity of ASUC as evidenced significantly higher prevalence of CMV in patients with toxic megacolon than those without 
(46% vs. 9%).29 In the present study, IHC positivity and mere 
positivity for mucosal CMV DNA was not predictive of steroid nonresponse. However, high CMV DNA load of >2,000 cop-
ies/mg was able to predict steroid failure with a reasonable di-
agnostic accuracy, having a sensitivity of 53% and specificity of 90%. Like the present study, Roblin et al.30 in a study of 42 
patients also showed that CMV DNA >250 copies/mg was predictive of steroid failure. The differences in the cutoff values 
between ours and this study could be due to differences in de-
definitions of ASUC, response to steroid and patient popula-
tion.

We further analyzed the significance of CMV quantification in relation to disease severity as quantified by the AIIMS’ in-
dex (combination of baseline UCEIS and day 3 FCP). Interest-
ingly, on multivariate analysis, high CMV mucosal DNA load 
(> 2,000 copies/gm) was an additional predictor of steroid failure (OR, 10.2; 95% CI, 2.6–39.7) and colectomy (OR, 17.2; 
95% CI, 2.6–115.2) in addition to AIIMS’ index (OR, 39.8; 95%
CI, 4.4–364.4 for steroid failure and OR, 18.2; 95% CI, 2.9–
114.4 for colectomy). AIIMS’ index was a stronger predictor 
than CMV DNA load, indicating that disease severity is the 
most important predictor for steroid nonresponse, but signifi-
cance of CMV positivity in this setting indicates the additional 
value of CMV testing at baseline in a patient with ASUC. Fur-
ther, on combining AIIMS’ index and CMV load, we were able 
to correctly predict outcomes (steroid response or failure) in 
84% patients, and if a patient had either AIIMS’ index positive 
or CMV load >2,000 copies/mg, this resulted in a sensitivity of 
80% and specificity of 87% in predicting steroid failure.

Although done prospectively with a reasonable sample size, 
the study has certain limitations. We have demonstrated CMV 
DNA as an independent predictor of short-term outcomes in 
ASUC, but we could not dissect out its role—a marker of severe 
disease or a pathogenic agent increasing severity. Albeit some 
studies showed the usefulness of CMV viremia or antigen-
emia in this setting, we did not test it in our patients.30 We 
could treat only 7 episodes with ganciclovir as the decision to treat was based on IHC positivity, which precluded us from making any conclusion. We did not include results of long-
term follow-up, as we intended to highlight the effect of CMV 
on steroid response and short-term outcomes of ASUC. So, a 
large prospective study with treatment decisions based upon 
CMV DNA results is needed to clarify the unanswered ques-
tions of the present study. Despite these limitations this study 
evaluated the role of quantitative CMV PCR in relation to oth-
er markers of disease severity as a predictor of steroid failure 
or colectomy in a reasonably large cohort of patients with 
ASUC.

To conclude high mucosal CMV DNA load (>2,000 copies/ 
mg) independently predicts failure of IV corticosteroids and 
short-term risk of colectomy in patients with ASUC. It has an 
additional value to the established markers of disease severity 
in ASUC.

ADDITIOnAL INFORMATION

Funding Source
This work was supported in part by the National Institute for 
Health Research (NIHR) Oxford Biomedical Research Centre 
(BRC) and Scheme for Promotion of Academic and Research 
Collaborations (SPARC).

Conflict of Interest
Travis SP is an editorial board member of the journal but did not 
involv in the peer reviewer selection, evaluation, or deci-
sion process of this article. No other potential conflicts of inter-
est relevant to this article were reported.

Author Contribution
Conceptualization: Jain S, Namdeo D, Sahu P, Kedia S, Ahuja V. 
Data curation: Jain S, Namdeo D, Sahu P. Formal analysis: Jain 
S, Sahu P, Ahuja V. Funding acquisition: Ahuja V. Investigation: 
Jain S, Namdeo D, Sahu P, Kedia S, Das P, Sharma R, Dar L. Meth-
odomology: Jain S, Namdeo D, Sahu P, Kedia S, Ahuja V. Project 
administration: Kedia S, Sahni P, Makharia G, Dar L. Supervi-
sion: Kedia S, Sahni P, Das P, Sharma R, Gupta V, Makharia G,
Dar L, Travis SP, Ahuja V. Validation: Jain S, Namdeo D, Sahu P, Kedia S, Sahni P, Das P, Gupta V, Travis SP, Ahuja V. Writing - original draft: Jain S, Namdeo D, Sahu P. Writing - review & editing: Jain S, Namdeo D, Sahu P, Kedia S, Sahni P, Das P, Travis SP, Ahuja V. Approval of final manuscript: all authors.

Others

We are particularly grateful to our patients, colleagues, nursing, pharmacy, clerical staff and allied professionals who collectively support our IBD services and enable studies such as this to be performed.

ORCID

Jain S https://orcid.org/0000-0002-2947-7836
Namdeo D https://orcid.org/0000-0001-5276-2398
Sahu P https://orcid.org/0000-0002-9847-0136
Kedia S https://orcid.org/0000-0002-5758-0144
Sahni P https://orcid.org/0000-0002-6910-062X
Das P https://orcid.org/0000-0002-2420-8573
Sharma R https://orcid.org/0000-0001-5181-263X
Gupta V https://orcid.org/0000-0002-9620-1696
Makharia G https://orcid.org/0000-0002-2474-2194
Dar L. https://orcid.org/0000-0002-9228-1799
Travis SP https://orcid.org/0000-0002-2690-4361
Ahuja V https://orcid.org/0000-0002-1577-0118

Supplementary Material

Supplementary materials are available at the Intestinal Research website (https://www.irjournal.org).

REFERENCES

See “High mucosal cytomegalovirus DNA helps predict adverse short-term outcome in acute severe ulcerative colitis” on page 1-10.

**Supplementary Table 1. Multivariable Analysis for Prediction of Colectomy during Index Admission in Acute Severe Ulcerative Colitis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative CMV DNA &gt; 2,000 copies/mg</td>
<td>17.2 (2.6–115.2)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>AIIMS index</td>
<td>18.2 (2.9–114.4)</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

OR, odds ratio; CI, confidence interval; CMV, cytomegalovirus; AIIMS, All India Institute of Medical Sciences.