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Predictors of Cesarean Delivery in Pregnant Women with Inflammatory Bowel Disease

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Abstract

Aim: Pregnant women with Crohn's disease (CD) or ulcerative colitis (UC) are likelier to undergo Cesarean delivery than women without IBD. Active perianal disease is the only IBD-related indication for Cesarean delivery. We sought to identify clinical factors contributing to these high rates.
Methods: We conducted a retrospective cohort study of 369 pregnant women with IBD who delivered at our institution between 2006 and 2014. We used logistic regression to identify clinical predictors of Cesarean delivery.
Results: The Cesarean delivery rate among women with CD and UC were 52% and 48%, respectively. Thirty of Cesarean deliveries (54%) in CD and UC patients were performed emergently, respectively. Among those with CD, the strongest predictors of Cesarean delivery were history of perianal disease (adjusted odds ratio [aOR), 13.6; 95% CI: 3.87–47.5) and prior Cesarean delivery (aOR, 22.2; 95% CI: 6.16–80.2). Among women who underwent Cesarean delivery because of perianal disease, only 42% had active perianal symptoms during pregnancy. In UC patients, history of colectomy was a predictor of Cesarean delivery (aOR, 5.08; 95% CI: 1.95–13.2). Cesarean delivery increased the postpartum length of stay by 1.1 days on average for both CD and UC patients, reflecting a 57% and 90% increase over vaginal delivery after adjusting for confounders.
Conclusions: The decision to perform Cesarean delivery for women with IBD is complex involving IBD-related and obstetric factors and is ideally made by a multidisciplinary team that includes input from a gastroenterologist and obstetrician.

Keywords: *cesarean; IBD; pregnancy.*

Abbreviations:
CD, Crohn's disease;
UC, ulcerative colitis;
IBD, inflammatory bowel disease

INTRODUCTION

Pregnant women with Crohn's disease (CD) or ulcerative colitis (UC) are at higher risk of adverse peripartum outcomes when compared with the non-IBD pregnant population. This could possibly be secondary to malnutrition, inflammation and medication use in the IBD pregnant population (1). Specifically, rates of Cesarean section have been found to be higher in IBD women versus those without IBD (2). From retrospective studies, Cesarean deliveries have been performed in situations where there was a maternal indication to avoid vaginal delivery, such as patients with perianal disease involvement (3). From large population-based studies, there was evidence

for higher Cesarean rates with CD but not UC, owing to the concern regarding perianal disease and anal sphincter damage (3). Other studies demonstrated an increased rate of Cesarean delivery with UC, as well as CD (1). A prior retrospective study suggested that CD women without a history of perianal disease had an 18% chance of developing perianal disease after vaginal delivery, particularly following episiotomy (4).

Current guidelines suggest Cesarean delivery in the presence of active perianal disease but not necessarily for women with inactive perianal disease (5). Additionally, Cesarean delivery may be considered for women who have ileal pouch-anal anastomosis, since they may be at risk of pouch dysfunction and sphincter damage with possible subsequent incontinence (1). Current opinion suggests that the mode of delivery in an IBD patient population should be decided by considering patient preference and joint input from gastroenterologists, obstetricians and, if appropriate, surgeons (6).

A large population-based study has identified IBD diagnosis as a significant predictor of adverse pregnancy outcomes (7). However, there is a sparsity of literature on what factors influence the decision to perform Cesarean delivery and its impact on resource utilization. Our aim was to retrospectively assess clinical predictive factors for Cesarean delivery in pregnant women with IBD.

METHODS

Study Population

We included all pregnant women with known diagnosis of IBD who delivered at our institution between April 1, 2006, and March 31, 2014. We used hospital discharge abstracts from Mount Sinai Hospital to identify women with a primary or secondary diagnosis code for IBD (ICD10 code: K50.x or K51.x) and a Canadian Classification of Health Interventions (CCI) code for a delivery intervention (all codes between 5MD50AA and 5MD60RH). Upon validation against the hospital medical record, the administrative codes exhibited a 100% positive predictive value for identifying pregnant women with IBD who gave birth. We obtained clinical information on 369 IBD patient deliveries at Mount Sinai Hospital between 2006 and 2014.

Retrospective chart review was performed on eligible patients who met the inclusion criteria. Data was collected in standardized fashion using a data abstraction form and subsequently entered into an electronic database. The following data elements were collected: date of admission and discharge; age at delivery and IBD diagnosis; CD or UC diagnosis; history of past or active perianal disease; history of IBD surgery; presence of IBD symptoms at time of delivery (based on physician global rating score and categorized as remission versus non-remission); maternal health issues (preeclampsia, placenta previa, placental abruption, gestational diabetes mellitus, hypertension, pregnancy-induced hypertension); obstetrical variables such as history of Cesarean section or vaginal delivery, as well as indication for Cesarean section, birth complications and length of stay. The primary outcome was Cesarean delivery. Secondary outcomes included length of stay and complications from Cesarean delivery.

Statistical Analysis

The statistical analyses were performed using Stata 14.1 (StataCorp LP, College Station, Texas). Data analyses were stratified by IBD subtype (CD versus UC). Categorical variables were compared using the chi-square test, and continuous variables were compared using the student *t* test or the Mann-Whitney test, when appropriate. For CD, the clinical predictors of Cesarean delivery were assessed using a multiple logistic regression model with the following independent variables: maternal age, history of perianal disease, history of bowel resection, presence of coexisting maternal disorders, prior Cesarean delivery, and presence of chronic maternal infections (hepatitis B, hepatitis C, human immunodeficiency virus). Maternal age was included in the model because it has been shown to be a predictor of Cesarean delivery (8). For UC, a similar logistic regression model was used except for the absence of perianal disease as a predictor variable. A multiple linear regression model was used determine the influence of Cesarean delivery on postpartum length of stay while adjusting for the same predictor variables as in the logistic regression models. Postpartum length of stay was log-transformed for the regression analysis. To account for clustering by physician, a robust variance estimator was used for all regression models.

RESULTS

We identified 369 women with IBD (CD, N = 228; UC, N = 141) who delivered at our institution during the 8-year study period.

Crohn's Disease

The majority (52%) of women with CD who delivered underwent Cesarean delivery. Nearly one third of these Cesarean deliveries (30%) were emergent. Among non-emergent Cesarean deliveries, the indications were inactive perianal disease (27%); active perianal disease (23%); other Crohn's related indications (11%); prior Cesarean delivery (15%); breech or obstructed labor (11%); other obstetric indications (11%).

The disease characteristics of women with CD who underwent vaginal versus Cesarean delivery are summarized in Table 1. Women who had Cesarean delivery were more likely than those with vaginal delivery to have a history of perianal disease (44% versus 6%, $P < 0.0001$), have active perianal disease (18% versus 1%, $P < 0.0001$), and history of perianal surgery (18% versus 3%, $P < 0.0001$). Among women who had a history of perianal disease and underwent Cesarean

Table 1. Demographic and clinical characteristics of women with Crohn's disease stratified by vaginal and Cesarean delivery

Characteristic	Vaginal delivery(N = 109)	Caesarean delivery(N = 119)	*P* value
Maternal age, mean (SD), years	32.6 (3.8)	33.7 (4.2)	0.04
Age at IBD diagnosis, mean (SD), years	21.9 (6.6)	22.3 (6.7)	0.68
Gestational age at delivery, mean (SD), weeks	38.1 (2.8)	37.8 (2.0)	0.37
Prior IBD surgery	49 (45%)	43 (36%)	0.18
History of perianal disease	7 (6%)	52 (44%)	<0.0001
Prior perianal disease surgery	3 (3%)	22 (18%)	<0.0001
Active perianal disease during pregnancy	1 (1%)	22 (18%)	<0.0001
Active IBD symptoms during birth admission	15 (14%)	34 (29%)	0.007
IBD meds during pregnancy	43 (39%)	66 (55%)	0.02
Maternal health problem*	12 (11%)	17 (14%)	0.46
Maternal chronic infection†	1 (1%)	5 (4%)	0.13
Prior Cesarean delivery	3 (3%)	46 (39%)	<0.0001

P value < 0.05 representing statistical significance.

* Includes preeclampsia, placenta previa, diabetes, hypertension, placental abruption and pregnancy-induced hypertension.

† Includes human immunodeficiency virus (HIV), hepatitis B and hepatitis C

delivery, less than half (42%) had active disease during the current pregnancy. Women who had Cesarean delivery were more likely to have had active IBD symptoms at the time of delivery (29% versus 4%, $P = 0.007$). They were also more likely to have had a history of prior Cesarean delivery (39% versus 3%, $P < 0.0001$). Nearly three-quarters (74%) of women with history of perianal disease but without any active perianal symptoms and without history of prior Cesarean delivery underwent Cesarean delivery.

The average postpartum length of stay (PLOS) was 1.1 days longer among those who underwent Cesarean versus vaginal delivery (3.1 versus 2.0 days, $P < 0.0001$). After multivariable adjustment, Cesarean delivery was associated with a 57% (95% CI: 36% to 81%) increase in the postpartum length of stay, while the presence of maternal comorbid association was linked with a 40% longer LOS after delivery (95% CI: 12% to 74%).

After adjusting for potential confounders, history of perianal disease was strongly associated with Cesarean delivery (adjusted odds ratio [aOR], 13.6; 95% CI: 3.87–47.5) (Table 3). When we stratified the analyses by emergent versus non-emergent Cesarean delivery, other statistically significant predictors in the model included history of prior Cesarean delivery (aOR, 22.2; 95% CI: 6.16–80.2) and maternal comorbid condition (aOR, 3.59; 95% CI: 1.41–9.15). The association with perianal disease was only significant among non-emergent Cesarean deliveries (aOR, 22.9; 95% CI: 5.9–88.9) but not in emergent Cesarean deliveries (aOR, 4.72; 95% CI: 0.77–28.9). When we stratified the analyses by emergent versus non-emergentCesarean delivery, other statistically significant predictors inthe model included history of prior Cesarean delivery (aOR, 22.2; 95% CI: 6.16–80.2) and maternal comorbid condition (aOR, 3.59; 95% CI: 1.41–9.15).

Ulcerative Colitis

There were 141 women with UC who delivered at our institution during the study period, 48% of whom underwent Cesarean delivery. Among the 67 Cesarean deliveries among women with UC, the majority (54%; n = 36) were performed emergently. Among non-emergent Cesarean deliveries, the indications were prior colectomy (35%); prior Cesarean delivery (23%); breech presentation (16%); other obstetric indications (13%); UC diagnosis without history of colectomy (10%); and other (3%).

Table 2 shows the demographic and disease characteristics between those who underwent vaginal versus Cesarean delivery. Women who underwent Cesarean delivery were older at birth admission (33.5 versus 31.9 years, $P = 0.04$) and were younger at IBD diagnosis (22.0 versus 24.5 years, $P = 0.03$). There were no differences in disease extent or the presence of active IBD symptoms at time of delivery. Those who had undergone Cesarean delivery were more likely to have a history of colectomy than those who delivered vaginally (40% versus 12%, $P < 0.0001$). While 39% of women who received Cesarean delivery had prior Cesarean delivery, none of the women who underwent vaginal delivery did ($P < 0.0001$). They also more frequently had coexisting maternal health conditions (19% versus 8%, $P = 0.05$). After multivariable logistic regression, prior colectomy was a significant predictor of Cesarean delivery (aOR, 5.08; 95% CI: 1.95–13.2; see Table 3). This association was similar for non-emergent Cesarean deliveries (aOR, 5.53; 95% CI: 1.75–17.4) and emergent Cesarean deliveries (aOR, 4.88; 95% CI: 1.61–14.8). Prior Cesarean delivery could not be included in the model because it perfectly predicted no vaginal delivery.

The postpartum length of stay was longer among women who underwent Cesarean delivery compared with those who

Table 2. Demographic and clinical characteristics of women with ulcerative colitis stratified by vaginal and Cesarean delivery

Characteristic	Vaginal delivery(N = 74)	C-section(N = 67)	*P* value
Maternal age, mean (SD), years	31.9 (4.2)	33.5 (4.8)	0.04
Age at IBD diagnosis, mean (SD), years	24.5 (5.8)	22.0 (6.2)	0.03
Gestational age at delivery, mean (SD), weeks	38.2 (3.2)	37.3 (2.7)	0.05
Prior colectomy	9 (12%)	27 (40%)	0.0001
Active IBD symptoms during birth admission	12 (16%)	5 (7%)	0.13
IBD meds during pregnancy	32 (43%)	27 (40%)	0.72
Maternal health problem*	6 (8%)	13 (19%)	0.05
Maternal chronic infection†	4 (5%)	1 (1%)	0.21
Prior Cesarean delivery	0 (0%)	26 (39%)	<0.0001

P value < 0.05 representing statistical significance.

* Includes preeclampsia, placenta previa, diabetes, hypertension, placental abruption and pregnancy-induced hypertension.

† Includes human immunodeficiency virus (HIV), hepatitis B and hepatitis C

had vaginal birth (3.7 versus 2.8 days; $P < 0.0001$). After multivariate regression, Cesarean delivery was associated with 90% higher postpartum length of stay (95% CI: 53% to 135%). There was a 3% shorter postpartum length of stay for every incremental year in maternal age.

DISCUSSION

Our study showed that the most important driving factors for Cesarean delivery in women with IBD were history of perianal disease for those with CD and history of colectomy for women with UC. Interestingly, we found that in women for whom perianal disease was listed as the indication for Cesarean delivery, more than half had inactive perianal disease, for which vaginal delivery is recommended in current guidelines. Additionally, 10% of IBD patients underwent Cesarean because of a diagnosis for CD or UC, but no specific indication. Our findings suggest that future adherence to clinical guidelines may reduce the need for Cesarean delivery and its economic impact.

Numerous studies have consistently shown that pregnant women with IBD are more likely than women without IBD to undergo Cesarean delivery (2, 3, 7). However, one European multicentre prospective cohort study showed no difference in Cesarean delivery rates between women with IBD and matched non-IBD controls (9). A meta-analysis by Cornish et al. identified a higher rate of Cesarean in CD versus non-IBD controls, which was not observed in the UC population (10). In our study, we specifically assessed mode of delivery stratified by CD and UC diagnosis. Our study found high rates of Cesarean delivery for both UC and CD, which is approximately twice as high as the national average of 28% (11).

The predominant indications for Cesarean delivery in our population were perianal disease in CD and history of colectomy for UC. For CD patients, this pattern of practice underscores health care provider concerns regarding the potential for

Table 3. Multivariable logistic regression of predictors of Cesarean delivery

Variable	Crohn's disease adjusted odds ratio (95% CI)	Ulcerative colitis adjusted odds ratio (95% CI)
Maternal age, mean (per year)	1.06 (0.97–1.15)	1.07 (0.98–1.16)
History of any perianal disease	13.6 (3.87–47.5)	Not included
Prior IBD surgery*	0.54 (0.27–1.10)	5.08 (1.95–13.2)
Active IBD symptoms during birth admission	1.13 (0.45–2.82)	0.39 (0.12–1.33)
IBD meds during pregnancy	1.74 (0.86–3.50)	1.72 (0.77–3.85)
Maternal health problem†	3.59 (1.41–9.15)	2.44 (0.77–7.70)
Maternal chronic infection‡	8.29 (0.81–85.1)	0.22 (0.02–2.17)
Prior Cesarean delivery	22.2 (6.16–80.2)	Not included

P value < 0.05 representing statistical significance.

* For CD, any IBD-related bowel resection; for UC, history of colectomy

† Includes preeclampsia, placenta previa, diabetes, hypertension, placental abruption and pregnancy-induced hypertension.

‡ Includes human immunodeficiency virus (HIV), hepatitis B and hepatitis C

perianal trauma from vaginal delivery or the deterioration of preexisting perianal disease (1). Kornfeld et al. (1997) showed that women with CD who had no history of preexisting perianal disease had an 18% chance of *de novo* disease subsequent to delivering vaginally, especially if episiotomy was performed (4). In contrast, Ilnyckyji et al. found no increased risk of new perianal disease following vaginal delivery among women with CD with no prior perianal disease (11). In this population-based study, only one out of 27 women developed new perianal disease subsequent to vaginal delivery with episiotomy (12). Ananthakrishnan et al. similarly found no increased risk of new-onset perianal disease following vaginal delivery (13). Other studies suggest the inactive perianal disease is not associated with worsening symptoms following vaginal delivery (1). However, there is a paucity of data to support actual harm from vaginal deliveries in CD women with inactive perianal disease (14). In a retrospective study of women with history of perianal disease, Cheng et al. showed there was no difference in worsening of perianal symptoms between those who had vaginal and Cesarean delivery (15). Current guidelines recommend Cesarean delivery for CD only in the presence of active perianal disease, not inactive disease (5). In our study, more than half of the women who underwent Cesarean delivery for perianal disease actually had inactive disease, and vaginal delivery could have been attempted in these cases.

For women with UC, there is general concern that vaginal delivery may precipitate sphincter dysfunction, leading to incontinence in those who have undergone ileal pouch anal anastomosis (IPAA) (16). There is some evidence for pouch dysfunction as manifested as increased stool frequency and incontinence, mostly in the third trimester, that is usually transient and dissipates postpartum, as demonstrated by Ravid et al. (17). The vast majority (83%) of these IPAA patients had returned to their pre-pregnancy pouch function following delivery (17). There was no significant difference in mode of delivery amongst the small subgroup of IPAA patients with persistent pouch dysfunction following delivery (17). Another study of 232 patients post-IPAA, also showed no difference in pouch dysfunction between the vaginal versus cesarean delivery group (18). Currently, there is a lack of long-term outcome data on pouch function following vaginal delivery. For this reason, current guidelines suggest Cesarean delivery be considered for patients with IPAA (8). However, this was a conditional recommendation, and the decision to undergo Cesarean should be individualized after discussions between the gastroenterologist, obstetrician and eliciting patient preference (5).

The main limitation of this study is that it was conducted at a single tertiary centre and may not be reflective of practices in community settings. The high rates of Cesarean delivery may be reflective of the high-risk populations seen at our centre. Future studies could compare our rates of Cesarean delivery to that of a community hospital while accounting for risk factors. Moreover, rates of Cesarean delivery were not compared to those of women without IBD from the same centre. Another limitation of the study was that we had very few patients with history of any perianal disease who underwent vaginal delivery. Thus, we could not compare the clinical history of inactive perianal disease following vaginal versus Cesarean delivery.

In conclusion, our study found high rates of Cesarean delivery driven by a history of perianal disease and prior colectomy. Because over half of patients who underwent Cesarean delivery for perianal disease had only inactive disease at the time of delivery, surgery could have been avoided. Cesarean deliveries increase not only the length of stay, with its associated costs, but also the risk of venous thromboembolism (2). Thus, knowledge dissemination of current guidelines may reduce overutilization of Cesarean delivery. It would be informative to assess trends in Cesarean delivery rates since the publication of the Toronto Consensus Guidelines for the Management of Inflammatory Bowel Disease in Pregnancy in 2016. Use of Cesarean delivery for IPAA patients remains discretionary, and more robust, prospective data on long-term clinical outcomes of these patients following vaginal delivery will better inform recommendations. The mode of delivery in IBD patients remains a collaborative decision that takes into account patient preferences and multidisciplinary input from gastroenterologists, obstetricians and colorectal surgeons.

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Institution Review Board Statement: This study was approved by the Mount Sinai Hospital Research Ethics Board prior to data collection.

Informed Consent Statement: The research ethics board deemed retrospective chart review exempt from the requirement to obtain informed consent.

Conflicts of interest statement: The authors have no conflicts of interest to report.

Authorship contributions: AS and GCN conceived and designed the study. AS performed all data collection and analyses, and all authors contributed to interpretation. AS drafted the manuscript and all authors critically reviewed it.

References

1. Ng S, Mahadevan U. Management of inflammatory bowel disease in pregnancy. Expert Rev. Clin. Immunol. 2013;9:161–74.
2. Nguyen GC, Boudreau H, Harris ML, et al. Outcomes of obstetric hospitalizations among women with inflammatory bowel disease in the United States. Clin Gastroenterol Hepatol. 2009;7:329–34.
3. Oron G, Yogev Y, Shcolnick S, et al. Inflammatory bowel disease: Risk factors for adverse pregnancy outcome and the impact of maternal weight gain. J Matern Fetal Neonatal Med. 2012;25:2256–60.
4. Kornfeld D, Cnattingius S, Ekbom A. Pregnancy outcomes in women with inflammatory bowel disease: A population-based cohort study. Am J Obstet Gynecol. 1997;177:942–6.

5. Nguyen GC, Seow CH, Maxwell C, et al. The Toronto consensus statements for the management of inflammatory bowel disease in pregnancy. Gastroenterology. 2016;150(3):734–57.
6. Beaulieu D, Kane S. Inflammatory bowel disease in pregnancy. World J Gastroenterol. 2011;17:2696–701.
7. Mahavedan U, Sandborn WJ, Li DK, et al. Pregnancy outcomes in women with inflammatory bowel disease: A large community-based study from Northern California. Gastroenterology. 2007;133:1106–12.
8. Bayrampour H, Heaman M. Advanced maternal age and the risk of cesarean birth: A systematic review. Birth. 2010;37(3):219–26.
9. Bortoli A, Pedersen N, Duricova D, et al. Aliment Pharmacol Therapeut 2011;34:724–34.
10. Cornish J, Tan E, Teare J, et al. A meta-analysis on the influence of inflammatory bowel disease on pregnancy. Gut. 2007;56:830–7.
11. Xie RH, Gaudet L, Krewski D, et al. Higher cesarean delivery rates are associated with higher infant mortality rates in industrialized countries. Birth. 2015;42(1):62–9.
12. Ilnyckyji A, Blanchard JF, Rawsthorne P, et al. Perianal Crohn's disease and pregnancy: Role of the mode of delivery. Am J Gastroenterol 1999;94:3274–8.
13. Ananthakrishnan AN, Cheng A, Cagan A, et al. Mode of childbirth and long-term outcomes in women with inflammatory bowel diseases. Dig Dis Sci. 2015;60:471–7.
14. Selinger CP, Leong R, Lal S. Pregnancy related issues in inflammatory bowel disease: Evidence base and patients' perspective. World J Gastroenterol. 2012;18:2600–8.
15. Cheng AG, Oxford EC, Sauk J, et al. Impact of mode of delivery on outcomes in patients with perianal Crohn's disease. Inflamm Bowel Dis. 2014;20:1391–8.
16. Van Assche G, Dignass A, Reinisch W, et al. The second European evidence-based Consensus on the diagnosis and management of Crohn's disease: Special situations. J Crohns Colitis. 2010;4:63–101.
17. Ravid A, Richard CS, Spencer LM, et al. Pregnancy, delivery, and pouch formation after ileal pouch-anal anastomosis for ulcerative colitis. Dis Colon Rectum. 2002;45:1283–8.
18. Hahnloser D, Pemberton JH, Wolff BG, et al. Pregnancy and delivery before and after ileal pouch-anal anastomosis for inflammatory bowel disease: Immediate and long-term consequences and outcomes. Dis Colon Rectum. 2004;47:1127–35.