# MELD-Na score as a predictor of anastomotic leak in elective colorectal surgery

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## ARTICLE INFO

## ABSTRACT

*Background:* For cirrhotic patients awaiting liver transplantation, the Model for End-Stage
Liver Disease Sodium (MELD-Na) model is extensively studied. Because of the simplicity
of the scoring system, there has been interest in applying MELD-Na to predict patient
outcomes in the noncirrhotic surgical patient, and MELD-Na has been shown to predict
postoperative morbidity and mortality after elective colectomy. Our aim was to identify the
utility of MELD-Na to predict anastomotic leak in elective colorectal cases.
*Methods:* The American College of Surgeons National Surgical Quality Improvement Pro-
gram targeted colectomy database was queried (2012-2014) for all elective colorectal pro-
cedures in patients without ascites. Leak rates were compared by MELD-Na score using chi-
square tests and multivariate logistic regression analysis.
*Results:* We identified 44,540 elective colorectal cases (mean age, 60.5 y $\pm$ 14.4, mean body
mass index 28.8 $\pm$ 6.6 kg/m$^2$, 52% female), of which 70% were colon resections and 30%
involved partial rectal resections (low anterior resections). Laparoscopic approach accounted
for 64.72% while 35.3% were open. The overall complication and mortality rates were 21% and
0.7%, respectively, with a total anastomotic leak rate of 3.4%. Overall, 98% had a preoperative
MELD-Na score between 10 and 20. Incremental increases in MELD-Na score (10-14, 15-19,
and $\geq$20) were associated with an increased leak rate, specifically in partial rectal resections
(3.9% *versus* 5.1% *versus* 10.7% P <0.028). MELD-Na score $\geq$20 had an increased leak rate when
compared with those with MELD-Na 10-14 (odds ratio [OR] 1.627; 95% confidence interval [CI]
[1.015, 2.607]). An MELD-Na score increase from 10-14 to 15-19 increases overall mortality (OR
5.22; 95% CI [3.55, 7.671]). In all elective colorectal procedures, for every one-point increase in
MELD-Na score, anastomotic leak (OR 1.04 95% CI [1.006, 1.07]), mortality (OR 1.24; 95% CI,
[1.20, 1.27]), and overall complications (OR 1.10; 95% CI [1.09, 1.12]) increased. MELD-Na was
an independent predictor of anastomotic leak in partial rectal resections, when controlling
for gender, steroid use, smoking, approach, operative time, preoperative chemotherapy, and
Crohn's disease (OR 1.06, 95% CI [1.002, 1.122]).

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*Conclusions:* MELD-Na is an independent predictor of anastomotic leak in partial rectal resections. Anastomotic leak risk increases with increasing MELD-Na in elective colorectal resections, as does 30-d mortality and overall complication rate. As MELD-Na score increases to more than 20, restorative partial rectal resection has a 10% rate of anastomotic leak.

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## Introduction

Approximately 600,000 colorectal procedures are performed annually in the United States for indications including cancer, inflammatory bowel disease (IBD), obstruction, ischemia, and diverticular disease.[1] Postoperative complication rates can be as high as 20%-30% after colectomy.[2] Leak rates have been reported between 1.8% and 15.9%.[3] This variability has been attributed to differences in type of resection and anastomotic level, with low anastomosis reported as having an increased risk factor in leak rates.[4] Anastomotic leak has been shown to increase morbidity and mortality, with the annual economic burden of anastomotic leaks after colorectal surgery estimated at $28.6 million when accounting for hospitalizations, readmissions and follow-up evaluations.[5] Some cohorts have shown a final overall mortality of 10.1% after anastomotic leak. Preoperative prediction of postoperative leak after colectomy remains largely subjective, based on clinical characteristics and the experience of the surgeon.

When evaluating a patient for surgery, it is ideal to use information such as preoperative comorbidities or common laboratory results to estimate risk. Transplant surgery serves as a model discipline that has successfully used a preoperative algorithm to risk stratify patients[6,7]. In patients with cirrhosis awaiting liver transplantation, the Model for End-Stage Liver Disease Sodium (MELD-Na) model is an effective predictor of surgical risk and extensively studied.[8] Current evidence establishes the revised MELD formula incorporating serum sodium as superior compared with the original model[9] particularly when evaluating patients with lower MELD values. MELD-Na scoring system uses the readily available laboratory values of bilirubin, international normalized ratio (INR), serum creatinine, and serum sodium.

Because of the success achieved with MELD-Na in transplant patients, there is interest in applying MELD-Na as an outcomes predictor in patient populations outside of transplant. MELD-Na has been shown to predict postoperative morbidity and mortality after elective colon cancer surgery.[10] Causey *et al.* reported that incremental increases in MELD-Na scores correlated with a 1.2% increase overall mortality and 1.1% increase in overall complications. The goal of this study was to determine the predictive value of MELD-Na on the incidence of anastomotic leaks after colorectal surgery using a large comprehensive national database with anastomotic leak information captured. Determination of a relationship between the MELD-Na score and the rate of anastomotic leaks serves to further validate MELD-Na as a predictor of poorer outcomes after colorectal surgery.

## Methods

### Data source

The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) colectomy-targeted database from 2012 to 2014 was used for this study.[11] Demographics, comorbidities, and 30-d outcomes were compared. ACS-NSQIP is a nationally validated, risk-adjusted, outcome-based program that provides a prospective, validated database of preoperative to 30-d postoperative outcomes clinical data. The data are collected by a dedicated surgical clinical nurse reviewer at each site after both inpatient and outpatient procedures (site accessed January 16, 2017). The targeted colectomy data set from 2012 to 2014 was merged with the general NSQIP data set by caseid to retrieve variables used to calculate the MELD-Na score. All elective colorectal procedures in patients without ascites were included. Current Procedural Terminology codes for colectomy included 44,140, 44,141, 44,143, 44,144, 44,147, 44,150, 44,151, 44,160, 44,204, 44,205 and for partial rectal resection 44,145, 44,146, 44,207, 44,208 were used for this study. The inclusion of the low anterior resection Current Procedural Terminology codes indicates resection for diverticulitis with coloproctostomy and sigmoid cancer with coloproctostomy. Rectal cancer resections are not included in the NSQIP colectomy database. Leak rates were compared by MELD-Na score using chi-square tests and multivariate logistic regression analysis. Anastomotic leak was the principal outcome of interest in this study and was defined in the colectomy-targeted data set. Only patients undergoing elective colorectal resection were included, and we excluded patients with ascites or liver disease with varices.

### MELD-Na calculation

The NSQIP does not record MELD-Na score; therefore, MELD-Na was derived from its preoperative values. This approach has been used in two previous studies using the NSQIP database (Ecker 2014[12] and Causey 2014[10]), the following methodology was used: MELD score $= 3.8 \times [\log (e) (\text{bilirubin mg/dL})] + 11.2 \times [\log (e) (\text{INR})] + 9.6 \times [\log (e) (\text{creatinine mg/dL})] + 6.43$, with a lower limit of 1 for all variables and with creatinine capped at 4; creatinine was set at 4 if the patient was receiving renal replacement therapy. This was then applied to the MELD-Na equation MELD Na $=$ MELD $-$ Na $- [0.025 \times \text{MELD} \times (140 - \text{Na})] + 140$, where the serum sodium concentration (Na) is bound between 125 and 140 mmol/L. The MELD-Na score was rounded to the nearest integer.

### Study design

This study was constructed to evaluate association between MELD-Na scores and anastomotic leak. In addition, patient