

Original Research Article

C-reactive protein as an early marker of anastomotic leak after elective intestinal transit restoration surgery: a retrospective study in Hidalgo, Mexico

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ABSTRACT

Background: Anastomotic leak is one of the most serious complications of intestinal surgery, and its early diagnosis remains difficult in hospitals with limited access to imaging. This study evaluated whether a serum C-reactive protein (CRP) concentration above 135 mg/l on postoperative day 3 is associated with anastomotic leak after elective intestinal transit restoration surgery.

Methods: This observational, retrospective study reviewed the clinical and laboratory records of adults who underwent elective intestinal transit restoration at the Dra. Columba Rivera Osorio General Hospital, Pachuca, Hidalgo, Mexico, between January 2021 and January 2024. CRP on postoperative day 3 was dichotomised at 135 mg/L and cross-tabulated against anastomotic leak. Association was tested with the Chi-square test ($\alpha=0.05$) and its strength with Cramér's V.

Results: Of 50 records reviewed, 36 patients were included. Anastomotic leak occurred in 6 patients (16.7%) and CRP exceeded 135 mg/l in 10 (27.8%). All six patients with a leak had CRP above the cut-off, and no leak occurred among the 26 patients below it. The association was significant ($\chi^2=18.72$, $p<0.001$) and strong (Cramér's $V=0.72$); sensitivity was 100%, specificity 86.7%, positive predictive value 60% and negative predictive value 100%. Type of anastomosis, anastomotic site and underlying diagnosis were not associated with leak.

Conclusions: A CRP above 135 mg/l on postoperative day 3 was strongly associated with anastomotic leak. As a low-cost, widely available test, CRP may serve as an early warning and rule-out tool in resource-limited hospitals, complementing clinical assessment and imaging. Larger prospective studies should validate this cut-off.

Keywords: Anastomotic leak, Biomarker, C-reactive protein, Colorectal surgery, Intestinal anastomosis, Postoperative complications

INTRODUCTION

Intestinal anastomosis is among the most frequently performed procedures in general and colorectal surgery, and anastomotic leak remains its most feared complication despite advances in surgical technique,

suture materials and perioperative care. A leak is a defect in the integrity of a surgical join between two hollow viscera that allows communication between the intraluminal and extraluminal compartments. It may cause a localised abscess or progress to generalised peritonitis and septic shock, with reported mortality of

6% to 22%, and it prolongs hospital stay, increases reoperation rates and costs and, in oncological patients, may worsen long-term survival.¹

Reported incidence depends on the level of the anastomosis: approximately 1% to 4% for ileocolic, 0.5% to 18% for colorectal and 5% to 19% for coloanal anastomoses. Early signs such as fever, tachycardia, tachypnoea and ileus are non-specific and overlap with the normal postoperative course, so the diagnosis is often delayed until about the fourth postoperative day, when the patient may already be septic.^{1,2} Contrast-enhanced computed tomography is the diagnostic reference standard, with a reported accuracy of 94% to 100%, but it is not always available, requires contrast media and cannot be applied routinely to every patient.²

CRP is an acute-phase protein synthesised by the liver in response to interleukin-6, tumour necrosis factor- α and interleukin-1 β . It rises within hours of surgery, peaks at about 48 hours and then declines unless an infectious complication develops.³⁻⁵ A value that fails to fall, or that rises on the third postoperative day, therefore signals a departure from normal recovery. Proposed cut-off values range from about 125 to 190 mg/l depending on the postoperative day and the population studied, and the evidence consistently indicates that CRP is most useful for its high negative predictive value.⁵⁻⁹

Very little of this evidence comes from Latin American public hospitals, where CRP is routinely available but same-day contrast-enhanced tomography often is not. An objective threshold could also reduce variability in clinical decisions, particularly in teaching hospitals where residents are the first to assess the patient. This study therefore aimed to determine whether a serum CRP concentration above 135 mg/l on postoperative day 3 is associated with anastomotic leak after elective intestinal transit restoration surgery, and to estimate the strength of that association.

METHODS

Study design and setting

An observational, descriptive, longitudinal and retrospective study was conducted in the General Surgery Service of the Dra. Columba Rivera Osorio General Hospital (ISSSTE), Pachuca, Hidalgo, Mexico. The clinical records of all patients who underwent intestinal transit restoration surgery between 1st January 2021 and 1st January 2024 were reviewed.

Selection criteria

Sampling was non-probabilistic and consecutive; the whole universe of eligible patients treated during the study period was analysed. Patients older than 18 years of either sex who underwent elective intestinal transit restoration surgery at the institution and had a serum CRP

measurement on 3rd postop day were included. Patients operated on as an emergency/outside study period, those with unknown American Society of Anesthesiologists (ASA) physical status and those without a CRP measurement on postoperative day 3 were excluded. Incomplete/unavailable records were eliminated.

Variables and data collection

The outcome was anastomotic leak, defined as documented evidence of intestinal content through the surgical wound or a drain and recorded as present or absent. The exposure was the serum CRP concentration on postoperative day 3, obtained from the laboratory information system (Modulab) and dichotomised at 135 mg/l. Secondary variables were sex, age group, underlying diagnosis, anastomotic site and anastomotic technique (hand-sewn or stapled). Data were extracted with a standardised collection sheet into a database that contained no patient identifiers.

Statistical analysis

Categorical variables were summarised as frequencies and percentages using Microsoft Excel. Associations between each variable and anastomotic leak were examined with contingency tables and the Chi-square test at a significance level of $\alpha=0.05$, and the strength of significant associations was estimated with Cramér's V. Because of the small expected counts, Fisher's exact test was also applied to the CRP table, and the sensitivity, specificity and predictive values of the cut-off were derived with exact 95% confidence intervals (CI).

Ethical considerations

The study was conducted with prior institutional authorisation and in accordance with the Regulations of the General Health Law on Health Research of Mexico (Articles 13, 14 and 16). As a records-based study without intervention, it was classified as research without risk and was exempt from individual informed consent under article 17, section I.

RESULTS

Fifty patients underwent intestinal transit restoration during the study period. Fourteen were excluded because the procedure was performed as an emergency, leaving 36 patients for analysis; all had a CRP measurement on postoperative day 3 and documentation of the presence or absence of leak. Twenty-one patients (58.3%) were women and 15 (41.7%) were men, and the most frequent age groups were 40 to 50 and 51 to 60 years (25.0% each) (Table 1). Neoplastic disease was the most common underlying diagnosis (13 patients, 36.1%), followed by strangulated hernia (33.3%), complicated appendicitis (19.4%), diverticular disease (8.3%) and abdominal trauma (2.8%). The anastomosis was

colorectal in 15 patients (41.7%), and 21 anastomoses (58.3%) were stapled.

Anastomotic leak occurred in 6 patients (16.7%). Leak was more frequent after hand-sewn than stapled anastomosis (26.7% versus 9.5%), but the difference was not significant ($p=0.17$). Neither anastomotic site ($p=0.54$) nor underlying diagnosis ($p=0.92$) was associated with leak (Table 2). CRP exceeded 135 mg/l on postoperative day 3 in 10 patients (27.8%).

All six patients who developed a leak were in this group, whereas none of the 26 patients with CRP at or below the cut-off leaked (Table 3). The association was statistically significant (Pearson $\chi^2=18.72$, $df=1$, $p<0.001$; Fisher's exact $p<0.001$) and strong (Cramér's $V=0.72$). The cut-off had a sensitivity of 100% (95% CI 54.1 to 100), a specificity of 86.7% (95% CI-69.3 to 96.2), a positive predictive value of the 60.0% (95% CI-26.2 to 87.8) and the negative predictive value of 100% (95% CI-86.8 to 100).

Table 1: Demographic characteristics of the study population (n=36).

Variables	N	Percentages (%)
Sex		
Female	21	58.3
Male	15	41.7
Age group (in years)		
<40	5	13.9
40-50	9	25.0
51-60	9	25.0
61-70	8	22.2
>70	5	13.9

Table 2: Anastomotic technique, anastomotic site and underlying diagnosis according to anastomotic leak.

Variables	No leak (n=30)	Leak (n=6)	Total (n=36)	P value*
Anastomotic technique				
Hand-sewn	11	4	15	0.17
Stapled	19	2	21	
Anastomotic site				
Colorectal	13	2	15	0.54
Ileocolic	6	2	8	
Ileo-ileal	4	2	6	
Jejuno-jejunal	4	0	4	
Jejuno-ileal	3	0	3	
Underlying diagnosis				
Strangulated hernia	10	2	12	0.92
Colon cancer	7	1	8	
Complicated appendicitis	5	2	7	
Rectal cancer	3	1	4	
Diverticular disease	3	0	3	
Ileal cancer	1	0	1	
Abdominal trauma	1	0	1	

*Chi-square test.

Table 3: Serum CRP on postoperative day 3 according to anastomotic leak.

CRP on postoperative day 3	No leak	Leak	Total
≤135 mg/L	26	0	26
>135 mg/L	4	6	10
Total	30	6	36

*Pearson $\chi^2=18.72$, $df=1$, $p<0.001$; likelihood-ratio $\chi^2=18.98$, $p<0.001$; Cramér's $V=0.72$.

DISCUSSION

In this series, a CRP concentration above 135 mg/l on the third postoperative day was strongly and significantly

associated with anastomotic leak after elective intestinal transit restoration. The cut-off lies within the range reported in recent meta-analyses, which found CRP to be a useful predictor of leak and, above all, a reliable rule-

out test.^{8,9} In agreement with that literature, no patient with a CRP at or below the threshold leaked, whereas 4 of the 10 patients with an elevated value did not. An elevated CRP should therefore be read as a trigger for closer surveillance and targeted imaging rather than as a diagnosis, while a low value supports uneventful recovery and safe early discharge.^{5,10} Early identification also matters for outcome, since detection of leak with CRP has been reported to increase the chances of anastomotic salvage.¹¹

The day of measurement is critical. Raje et al found that CRP measured early after colorectal surgery was not predictive of leak, which underlines that the test must be requested on the appropriate postoperative day.¹² The PREDICT study further showed that the trajectory of CRP over the first postoperative days predicts leak better than an isolated value.⁴ Our design relied on a single measurement on day 3, which is easy to implement in a busy public hospital but may sacrifice some diagnostic accuracy; combining the day 1 and day 3 values deserves evaluation in our setting.

Other markers have been proposed. Procalcitonin appears to add value mainly as a complement to CRP rather than as a stand-alone test, and its interpretation is more demanding and costly.^{13,14} Deep learning models built on perioperative data have shown promising performance but remain investigational and are not available in most public hospitals.¹⁵ For the foreseeable future, an inexpensive test that is already part of routine postoperative care remains the most practical option.

Most of the evidence on CRP comes from European and North American centres. Our findings agree with the limited Latin American data, including a previous Mexican series, and suggest that CRP behaves similarly in a Mexican public hospital.^{6,16} Anastomotic technique, anastomotic site and underlying diagnosis were not associated with leak, although distal location and several patient-related and technical factors are recognised risk factors; the sample was not powered to detect them.^{17,18}

This study has limitations. The sample was small (36 patients and 6 leaks), so the estimates have wide confidence intervals and a single misclassified patient could change them appreciably. The retrospective design depended on the completeness of clinical and laboratory records, and leak was identified clinically rather than with a standardised definition and grading system.¹⁹

CRP was measured only once, the cut-off was prespecified rather than derived from the data, the population was heterogeneous in diagnosis and anastomotic site, and the study was performed in a single centre. Prospective multicentre studies with serial CRP measurements and standardised confirmation of leak are needed to validate the threshold before it is adopted as an institutional standard.

CONCLUSION

A serum CRP concentration above 135 mg/L on the third postoperative day was strongly associated with anastomotic leak after elective intestinal transit restoration surgery, and no leak occurred below this value. Routine measurement of CRP on postoperative day 3 is a low-cost and readily available tool that can identify patients who need closer clinical assessment and imaging and can support safe discharge when the value is low, particularly in resource-limited hospitals. It should complement, not replace, clinical judgement and imaging.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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