



# The Effect of Preoperative and Peroperative Parameters on Postoperative Complications of Patients Followed in the Intensive Care Unit after Colorectal Cancer Surgery

## Yoğun Bakım Ünitesinde Kolorektal Kanser Cerrahisi Sonrası Takip Edilen Hastaların Preoperatif ve Peroperatif Değerlerinin Postoperatif Komplikasyonlara Etkisi

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### ABSTRACT

**Aim:** Surgery practiced in colorectal carcinomas is an important execution area in the clinic of anesthesia and critical care because of the wide range of co-morbid diseases that advanced-aged patients have and, preoperative preparation, operational and postoperative care features distinctive for the surgical process. To investigate distinctive factors between the groups with and without complications during perioperative period on patients who diagnosed colorectal carcinoma and have colorectal resection surgery.

**Method:** One hundred fifteen patients over 18 years old from two genders that have diagnosed as colorectal carcinoma and had intestinal resection at elective conditions have been investigated retrospectively. Patients were monitored at İstanbul University Faculty of Medicine Adult Intensive Care Unit between the years 2008 and 2010.

**Results:** Eighty (69%) of patients were male, 35 (31%) of patients were female. Hemoglobin levels of the groups with and without complication were 8.45±2.55 g/dL and 11.51±2.15 g/dL, respectively before the operation (p<0.0001). Similarly, thrombocyte count was 256±83.106/mm<sup>3</sup> in complication group while it was 281±13.106/mm<sup>3</sup> in no complication group (p=0.02); ratio of patient who have transfusion during operation is 48% in complication group and 27% in no complication group. Transfusion amounts were 2.2±0.7 and 1.2±0.1 units, respectively (p<0.0001).

**Conclusion:** An increase was observed in the postoperative complications frequency of the patients with lower hemoglobin level and thrombocyte count and received large amount, frequent blood transfusion during preoperative period.

**Keywords:** Colorectal resection, postoperative mortality, intensive care unit, hemoglobin

### ÖZ

**Amaç:** Kolon ve rektum kanserlerinde uygulanan cerrahi, gerek etkilediği ileri yaş grubu hastalarının taşıdığı çok sayıda yandaş hastalıklar, gerekse cerrahi sürecin kendine özgü hazırlık-ameliyat ve ameliyat sonrası bakım özellikleriyle; anestezi ve yoğun bakım kliniğinde önemli bir uygulama alanıdır. Çalışmamızda kolorektal kanser tanısı ile kolorektal rezeksiyon ameliyatı olan hastaların perioperatif süreçte komplikasyon yaşayan grup ile yaşamayan grup arasındaki ayırt edici parametreleri incelemeyi amaçladık.

**Yöntem:** 2008-2010 tarihleri arasında, 18 yaş üzerinde olup kolorektal kanser tanısı ile elektif koşullarda barsak rezeksiyonu yapılan ve ameliyat sonrası İstanbul Üniversitesi Tıp Fakültesi Erişkin Yoğun Bakım Ünitesi'nde takip edilmiş olan, her iki cinsten toplam 115 hasta retrospektif olarak araştırılmıştır.

**Bulgular:** Hastaların 80'i erkek (%69) 35'i ise (%31) kadındı. Komplikasyon yaşayan ve yaşamayan gruplarda ameliyat öncesi hemoglobin düzeyleri sırasıyla, 8,45±2,55 g/dL ve 11,51±2,15 g/dL idi (p<0,0001). Benzer şekilde trombosit sayısı da komplikasyonlu grupta 256±83,106/mm<sup>3</sup>, komplikasyonsuz grupta 281±13,106/mm<sup>3</sup> (p=0,02) olarak bulundu. Operasyon esnasında transfüzyon yapılan hasta oranı komplikasyonlu grupta %48, komplikasyon yaşamayan grupta %27 (p=0,005) iken, transfüze edilen miktarlar sırasıyla 2,2±0,7 ünite ile 1,2±1 ünite (p<0,0001) olarak gözlemlendi.

**Sonuç:** Preoperatif düşük hemoglobin ve trombosit sayım değerleri olan ve preoperatif dönemde daha sık ve fazla miktarda transfüzyon yapılan hastaların postoperatif komplikasyon sıklığında artış olduğu saptanmıştır.

**Anahtar Kelimeler:** Kolorektal rezeksiyon, postoperatif mortalite, yoğun bakım ünitesi, hemoglobin



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Received/Geliş Tarihi: 01.10.2015 Accepted/Kabul Tarihi: 05.04.2016

## Introduction

The bowel resection applied in the treatment of colorectal cancer is significantly related to both morbidity and mortality.<sup>1</sup> Because that the colorectal cancer is usually a disease of advanced age, diseases leading to significant comorbidities like ischemic heart disease, valvular heart disease, chronic pulmonary disease, hypertension and diabetes are commonly seen in those patients with diagnosis of colorectal cancer.<sup>2,3</sup> When an additional major surgery is planned for this patient group having risks of advanced age and comorbid diseases, the risks during operation and postoperative risk get more increased. During the operation, beside the negative effects of surgical intervention, there is a potential of anaesthetic agents to cause effect on organ functions. Possible negative effects are well tolerated in healthy individuals, however it may not be possible for cancer patients with limited functional capacity and with systemic diseases to tolerate and pass on this period. Thus, the preoperative preparation and medical assessment is considered to be an important issue in United States of America and some European countries that significantly affects the mortality during operation of colorectal surgery.<sup>4</sup> In our study, we aimed to examine retrospectively, the effects of some demographic, hemodynamic and biochemical parameters detected before, during and after the surgery on the complications that the patients were exposed, by using the data from follow up and evaluations recorded preoperatively, during and after the operations of patients applied resection due to colorectal cancer.

## Materials and Methods

As a total number of 115 patients of both sexes were examined retrospectively, who had been followed up postoperatively in Adolescent Intensive Care Unit (ICU) of İstanbul University Faculty of Medicine and who were over 18 years old having bowel resection in elective conditions with diagnosis of colorectal cancer between years 2008-2010 at General Surgery Department of İstanbul University Faculty of Medicine. Required approval was obtained from Ethics Committee. Patients were scanned by being divided in 3 groups as all patients in the first group; patients having complication in any period at second group and patients having no complication in the third group.

In this study, patient files in the archives of adolescent ICU and general surgery department were used and the following parameters were examined: demographic data, medical situation of patients [American Society of Anesthesiologists (ASA) score, concomitant diseases, drugs used], preoperative laboratory values, postoperative follow up and treatment strategy, surgery and anaesthesia technique

(open surgery-laparoscopy mediated surgery, inhalation-intravenous-combined general epidural), blood gas values, maximum base deficit, minimum hemoglobin (Hb), systolic and diastolic arterial blood pressure values at entry and exit of surgery, minimum arterial blood pressure and average central venous pressure values recorded during surgery, fluid balance during the surgery (applied crystalloid and colloid fluid and blood products, amount of urine output), duration of surgery, complications seen during surgery, length of stay in ICU after surgery, duration of mechanical ventilation, complications observed in ICU, complications seen in surgery service and discharge time.

A preoperative anaesthesia assessment form had already been filled up by a physician assistant of anaesthesia at the policlinic and bedside at surgery service, so the preoperative ASA scores, laboratory findings, concomitant diseases, drugs used and postoperative ICU predictive parameters were taken from these forms. In the evaluation of anesthesia forms of patients who had planned acceptance to ICU, the criteria were determined as; ASA 3 and 4 patients, obese ones with body mass index >30, old patients with low functional capacity, patients with airway problems with Mallampati scores of 3-4. The characteristics of patients who had unplanned acceptance to ICU were prolonged surgery time, excess intraoperative blood loss, being prone to risk of intraoperative surgery complications, prolonged extubation and regulation.

Our study included patients having elective bowel resection; emergently operated patients, under 18 year old patients and the one whose preoperative records had been unreached were excluded. The following parameters were considered to determine the presence of complication during the operation:

- 1. Hypertension:** Whatever the arterial blood pressure or position of patient at entry of surgery is, if systolic blood pressure during operation follow up was >160 mmHg and/or diastolic blood pressure was >90 mmHg, or if the systolic pressure detected at basal measurement was over 30% and this situation goes on at least 3 minutes.
- 2. Hypotension:** Whatever the arterial blood pressure or position of patient at entry of surgery is, if systolic blood pressure during operation follow up was <90 mmHg or if the systolic pressure detected at basal measurement was below 30% and required position regulation, bolus fluid and vasoactive agent.
- 3. Bradycardia:** The case that the heart apex beat was 40 beats per minute and medicine (atropine, ephedrine etc.) was applied to patient to correct the bradycardia.
- 4. Tachycardia:** The case that heart apex beat was 100 beats per minute and this situation continued despite efficient deep anesthesia and analgesia.

**5. Arrhythmia:** Detection of arrhythmia that hadn't been detected before surgery (atrial fibrillation, flutter, ventricular and atrial early beat, supraventricular tachycardia) and documentation of this on electrocardiography.

Beside these circulatory complications, also the metabolic, respiratory, thromboembolic events and other complications due to the surgery were scanned. Ignoring whether the patient was previously diabetes mellitus or not, a blood sugar level higher than 200 mg/dL during surgery was determined as Hyperglycemia, and a blood glucose level lower than 60 mg/dL was accepted as hypoglycemia during the surgery. An impairment of gas exchange and need to regulate artificial respiratory settings during surgery, need for non-invasive artificial respiratory support after the operation or presence of repeated intubation were all categorized as respiratory complications. It was evaluated whether the cause was embolism, atelectasia or pneumonia.

General anesthesia was applied to all the patients. For anesthesia induction, midazolam+fentanyl+propofol were used in all patients, vecuronium or atracurium were used as myorelaxant, and sevofluran, desfluran or isofluran were used for the maintenance of anesthesia.

The complications mentioned above (hypotension, hypertension, bradycardia, tachycardia, hyperglycemia) were recorded as early postoperative complication based on the same criteria. Surgical complications excluding the need to recall to ICU (wound infection, gastrointestinal motility delay), cardiovascular complications (newly appeared arrhythmia, myocardial ischemia) and respiratory complications (pulmonary infection, disorder of gas

exchange, prolonged need of respiratory physiotherapy) were recorded.

### Statistical Analysis

All data were given as mean  $\pm$  standard deviation. Statistical analysis was performed by using SPSS 15,0 (SPSS Inc, Chicago, IL, USA) pack program. Chi-square test was used to analyse the categorical data, t-test was used for the comparison of numerical data and  $p < 0.05$  was accepted as significant.

### Results

The medical record of 115 patients were retrospectively analysed who had been applied elective colorectal surgery in the operation rooms of General Surgery Department of İstanbul Faculty of Medicine between years 2008-2010. As a number of 95 patients accounted as 82.6% of all patients were accepted to ICU as planned, and 20 patients accounting 17.4% were accepted to ICU as unplanned with a decision during surgery or after operation. When all of the patients were considered as a single group, demographic characteristics and preoperative medical conditions are summarized in Table 1. The average age of the patients was detected to be 70.2 years.

Preoperative characteristics of the patient groups as complicated and uncomplicated are shown in Table 2. As a gender, 80 of the patients (69%) were male and 35 (31%) were female. Patients were divided in two groups, one as complicated and the other as uncomplicated according to complications they had preoperatively, postoperatively in early period at ICU and in later period at service follow up.

Table 1. Preoperative data of all patients

n=115	Average	Standard deviation	Minimum	Median	Maximum	Lower 95% CI	Upper 95% CI
Age (years)	70.26	9.58	29	72	90	68.49	72.04
ASA	2.91	0.28	2	3	3	2.86	2.96
Hb (g/dL)	11.62	2.35	7.2	11.3	24.1	11.19	12.06
Creatinine (mg/dL)	0.99	0.35	0.5	0.9	3	0.92	1.05
Thrombocyte (thousand/mm <sup>3</sup> )	269	99	104	261	640	251	288
Base Deficit (mmol/L)	-1.74	3.4	-11.6	-1.8	11.6	-2.36	-1.10
K (mEq/L)	3.28	0.52	2.1	3.2	4.7	3.18	3.37
Na (mEq/L)	139.51	3.91	129	140	152	138.8	140.2
Glucose (mg/dL)	124.42	36.74	60	114	295	117.64	131.22
Lactate (mmol/dL)	0.98	0.43	0.3	0.9	2.4	0.9	1.06

ASA: American Society of Anesthesiologists, Hb: hemoglobin, K: potassium, Na: sodium, CI: confidence interval

According to that, preoperative complication was observed in 53 patients (45%), while no complication was seen in 63 patients (55%). It was observed that intensive care follow up strategies were significantly different between two groups. Considering this, 38 patients from complicated group were transferred to ICU as planned, and 14 patients were transferred as unplanned because of unexpected events and instability during surgery or at the recovery room, so they were decided to follow in the ICU postoperatively. In the uncomplicated group, this ratio was recorded as 57 to 6 patients.

Preoperative hemogram and biochemical parameters of both groups are presented in Table 3. In the complicated group, preoperative Hb level was 8.45 g/dL, while it was 11.5 g/dL in the uncomplicated group in average ( $p<0.0001$ ). Similarly, thrombocyte count in complicated group was found to be significantly lower, compared to the uncomplicated group ( $p=0.02$ )

The main parameters obtained from the data of patients during surgical operations are summarized in Table 4.

It was observed that there was no perioperative mortality seen in study patients. The postoperative artificial respiration durations of patients were detected as  $3.94\pm4.47$  hours in complicated group, while detected as  $3.22\pm2.67$  hours in uncomplicated group. No significant difference was detected

between the groups considering artificial respiration time. When the time of staying at ICU was considered, this period was recorded as  $26.5\pm6.4$  hours in complicated group and  $18.3\pm4.7$  hours in uncomplicated group. It was detected that the times of stay at ICU were significantly different between two groups ( $p<0.001$ ). Hospital stay duration time was  $12.53\pm14.6$  days in complicated group and it was  $12.11\pm11.58$  days in the uncomplicated one. No significant difference was detected between two groups about discharge times.

When the concomitant diseases were evaluated as comorbidity for the patients, there was no additional detected concomitant disease in 7 of 115 patients. There was no complication in any of these 7 patients observed during the surgical operations. It was realized via the medical records of these patients that, their transfer to ICU due to prolonged surgical intervention, need for close follow surgically and the need for follow up due to bleeding-transfusion applications.

Comorbidities were classified as circulatory (hypertension, ischemic heart disease, valvular heart disease, systolic dysfunction), respiratory (chronic obstructive pulmonary disease, bronchial asthma, Sleep apnea syndrome), metabolic (obesity, diabetes mellitus) and neurological (past cerebrovascular event). According to this, among

Table 2. Preoperative demographic characteristics of patients and basic operative data (significant by \*Fisher's exact test)

	Complicated (n=52)	Uncomplicated (n=63)	p
Gender (M/F)	44/19	36/16	0.945
Age (year)	72±8.6	68.8±10	0.07
ASA status	2.86±0.34	2.95±0.21	0.84
Surgical technique (open/laparoscopic)	16/36	25/38	0.42
Intensive care acceptance (planned/unplanned)	38/14	57/6	0.024*
Operation duration (minute)	164±53	158±52	0.53

M: Male, F: female, ASA: American Society of Anesthesiologists

Table 3. Preoperative laboratory data of patients in group 1 and 2 (significant by \*Student t-test)

	Complicated (n=52)	Uncomplicated (n=63)	p
Hemoglobin (g/dL)	8.45±2.55	11.51±2.15	<0.0001*
Thrombocyte (106/mm <sup>3</sup> )	256±83	281±13	0.02*
Glucose (mg/dL)	118±39	112.17±29.27	0.34
Creatinine (mg/dL)	0.98±0.41	0.99±0.05	0.84
Lactate (mmol/L)	1.04±0.06	0.93±0.4	0.052
Base deficit (mEq/L)	-2.04±3.38	-1.42±3.42	0.38
Sodium (mEq/L)	139±4	139.9±3.8	0.17
Potassium (mEq/L)	3.3±0.55	3.93±0.4	0.68

Table 4. Data of patients during surgery (significant by \*Fisher's exact test, \*\*significant by student t-test)

	Complicated (n=52)	Uncomplicated (n=63)	p
Minimum Hb (g/dL)	10.37±1.82	10.73±1.77	0.29
Minimum systolic blood pressure (mmHg)	95±14	99±13	0.1
Minimum diastolic blood pressure (mmHg)	54±9	56±8	0.17
Maximum base deficit (mEq/L)	-2.96±3.27	-2.08±3.01	0.13
Postoperative fluid balance (mL)	2851±858	2762±788	0.56
Ratio of patients transfused during operation (%)	48	27	0.005*
Transfused amount (U)	2.2±0.7	1.2±1	<0.0001**

Hb: Hemoglobin

all patients, 26 of them (22%) were followed only for cardiovascular diseases, while 12 were (10%) followed only for respiratory system diseases. Other patients had additional neurological or metabolic problems beside these systemic diseases. Furthermore, 30 patients (26%) had type 2 diabetes mellitus. While all of the diabetic patients also had cardiac diseases, 5 of them also had respiratory and 2 of them had neurological disease symptoms additionally.

Beside the comorbidity, the patients were scanned also about medications they used. When the use of cardiovascular drugs (beta blockers, ACE-ARA group, calcium channel blockers), oral antidiabetic, antiobstructive, anticoagulant-antiaggregant are investigated and analysed, it was detected that 17 of 115 patients (14.7%) used no drug. Early or late complications were encountered in 4 of these patients. These complications were respectively; reoperation in ICU due to bleeding, atelectasis, hypertension and frequent atrial early beat at clinics. For the rest 98 patients, 22 of them were using single medication (eight using beta blocker, five taking ACE-ARA, four using antiobstructive and five taking oral antidiabetic) and others were detected to be using 2 or more drugs.

## Discussion

When the results of this study is evaluated, the following main points are drawing attention: The patients whose acceptance to ICU was planned had less complications compared to the patients whose ICU acceptance for postoperative follow was not planned. The patients who had anemia, lower thrombocyte count and who had more frequent plus more amounts of blood product transfusion had much more complicated surgery period than others.

Many clinical studies have been performed in various surgical disciplines about how postoperative prognosis is affected by the presence of preoperative anemia. Preoperative anemia is determined as independent risk factor for perioperative morbidity in both cardiac<sup>5</sup> and non-cardiac surgery.<sup>6,7</sup>

Anemia is more frequently and obviously observed in colorectal surgery patients.<sup>8</sup> In a study published by Leichtle et al.,<sup>9</sup> perioperative data of 23348 colorectal surgery candidates were examined retrospectively, and patients were scanned by classifying due to their anemia status as normal (Hct >38), mild (30-37), moderate (26-29), and severe (21-25). The results obtained by authors show that patients with mild, moderate or severe anemia are more prone to complications at both primary and secondary end points, compared to normohemoglobinemic patients. According to the results of our study, Hb level was 8.5 g/dL in complicated group, while it was 11.5 g/dL in uncomplicated group. The patients that we considered as complicated were convenient and equivalent to the moderate anemia group of Leichtle et al.,<sup>9</sup> and uncomplicated group was equivalent to mild anemia group of Leichtle et al.<sup>9</sup> In this case, we can say that the relationship between preoperative anemia level and perioperative complication frequency in our study is similar the same relationship found in the study of Leichtle et al.<sup>9</sup> As a result, preoperative anemia, regardless of its Hb level, leads to increase in the frequency of unwanted events during the operation period.

It is observed that the increase in transfusion frequency and amount leads to an increase in the frequency of complications. In both groups, to reach the Hb levels similar levels during operation, as an obligation, we had to apply more blood product transfusion to more patients in number. In a study by Benoist et al.<sup>10</sup> performed with 212 patients as candidates for colon surgery, they found a strong relation between transfusion and unwanted event frequency. Likewise, Transfusion Requirements in Critical Care (TRICC) study has demonstrated the negative effects of transfusion applications on the prognosis of the patients.<sup>11</sup> In this study, it was shown that the patients who were applied restrictive transfusion strategy (Hb level goal as 7-9 g/dL) had better prognosis in terms of morbidity and mortality, compared to those who were applied liberal transfusion strategy (Hb level goal as 10-12 g/dL). TRICC study, as

being a milestone study about transfusion strategies, had demonstrated that each applied blood product impairs the prognosis of the critical patient.

While Anemia itself complicates the operation period, correcting anemia by applying transfusion does not solve the problem conversely leads to additional problems. As one of the results of our study, the fact that patients with lower thrombocyte count are located in complicated group is not explained due to thrombocytopenia but be explained as the need for more transfusion in those patients, we esteem. Another point that must be kept in mind about blood transfusion in colorectal cancer surgery (although it is not a direct concern of our study) is the detection of a significant increase in cancer recurrence in the patients who had blood transfusion during surgery period.<sup>12</sup>

The second significant difference emerging in this study is that less complications were observed for the patients whose postoperative intensive care follow up had been planned, compared to the patient whose postoperative follow up had been planned to be in surgery service but transferred to ICU because of the complication during operation as unplanned. Although the data from retrospective scans couldn't demonstrate clearly, it may be considered that most of these patients got indication for ICU follow up because of the unexpected intraoperative bleeding or hemodynamic instability. In a study by Tassoudis et al.,<sup>13</sup> they demonstrated that the intraoperative hemodynamic events occurring in abdominal surgery applied patients are independent risk factors effective on postoperative morbidity of especially the hypotensive periods and hospital stay durations. In our study, despite no significant difference was seen between two groups considering the lowest blood pressure values recorded during surgery, probably the individually some prolonged hypotensive patients composed the patients who were transferred to ICU although it was unplanned. The fact that our study is retrospective makes it difficult to make more healthy and precise determination about the subject.

Apart from these two main topics which are anemia-transfusion duo and the property of need for ICU follow up unexpectedly, none of the parameters was detected to be significantly different by comparing the complicated and uncomplicated groups. In a study performed by Maia and Abelha<sup>14</sup> individual risk factors related to major cardiac complication as different from severity of surgery were found to be; a revised cardiac risk index over 2, high troponin I and high simplified acute physiology score. Similar to our study, age, gender, ASA scores and other hemodynamic and biochemical parameters were not found to be related to major complications, in that study.

In our study, it was observed that the artificial ventilation and ICU stay duration times were significantly long in

the patients experiencing a complicated period, but this difference was not available about discharge times. All of the patients were discharged at similar duration times. The effective factor on this issue is that the experienced complications hadn't changed into clinical conditions that have high morbidity and mortality potential like severe arrhythmia and myocardial infarct. Relatively, the side effects and complications with good prognosis did not carry their effects to late postoperative period.

## Conclusion

As a result of this study, it was detected that the most important factor during complication development period was anemia and the increased need for transfusion. Assessment of preoperative anemia in the patients who are candidates for colorectal surgery is essential for the prevention of complications. This is important to eliminate the failing of tissue oxygenation due to anemia and also to remove additional risks due to transfusion, by decreasing the need for transfusion; so it must be essentially considerable. In the presence of unwanted events happening during the operation, being followed in the ICU although it hadn't been planned, provides the recovery of the complications without any sequela and discharge of the patients without any additional delay. The increase in the frequency of complications triggered by unexpected event during surgery due to anemia-transfusion, may be a summary of the main result of this study.

## Ethics

Ethics Committee Approval: Ethics committee approval number; 2011/1123-607, 1156-2906-2011-09, Informed Consent: Obtained.

Peer-review: External and Internal peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar, Concept: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar, Design: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar, Data Collection or Processing: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar, Analysis or Interpretation: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar, Literature Search: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar, Writing: Cemal Bektaş, Ayhan Kaydu, Erhan Gökçek, Müslüm Güneş, Emre Çamcı, Cem Kıvılcım Kaçar. Conflict of Interest: No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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