

Clinical Surgery

# Mortality in patients with end-stage renal disease and the risk of returning to the operating room after common General Surgery procedures



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## KEYWORDS:

ESRD;  
Dialysis;  
Appendectomy;  
Ventral hernia repair;  
Cholecystectomy;  
Colectomy

## Abstract

**BACKGROUND:** The prevalence of end-stage renal disease (ESRD) has increased, and there is limited data on the risks faced by this patient population undergoing surgery.

**METHODS:** Using American College of Surgeons National Surgical Quality Improvement Program, we identified common surgical procedures undergone by patients with ESRD. These patients were compared with a matched-control group. A subanalysis was performed to determine the risk factors for returning to the operating room in patients with ESRD.

**RESULTS:** Of the 195,585 patients identified, 1,163 had ESRD. ESRD was associated with increased mortality (odds ratio [OR] 9.05, confidence interval [CI] 4.09 to 20.00) and rates of return to the operating room (OR 2.97, CI 1.99 to 4.46). Returning to the OR was associated with increased operation times (98.9 vs 130.2 minutes,  $P < .05$ ), mortality (OR 4.35, CI 2.11 to 8.99), and morbidity (OR 7.6, CI 4.68 to 12.41).

**CONCLUSIONS:** Patients with ESRD face greater risks when entering the operating room, and further study is needed to elucidate preventable risk factors.

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In the United States alone, more than 600,000 people are living with end-stage renal disease (ESRD).<sup>1</sup> The development of the disease is multifactorial, with pathologies spanning from diabetes to hypertension to drug-induced damage. Despite the increasing prevalence,

hemodialysis has resulted in improvement in care of patients with ESRD, resulting in decreased mortality rates since 2001, with the greatest mortality attributed to cardiac arrest.<sup>1</sup> As mortality decreases, this patient population is growing and new health care obstacles arise, including the need for these patients to undergo common surgical procedures. From the surgical perspective, the poor renal function and metabolic disturbances seen in patients with ESRD innately make them higher risk. Large analyses have investigated the effect of chronic kidney disease on all general and vascular surgery cases<sup>2</sup> and

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also major hepatectomy,<sup>3</sup> carotid endarterectomy,<sup>4</sup> and pancreatectomy.<sup>5</sup> However, these studies either look at all surgical cases or specific procedures with relatively high morbidity and mortality. These studies noted an increase in complication rates in the population with chronic kidney disease. Several studies have shown that in particular patients with ESRD on dialysis face increased rates of morbidity and mortality compared with their counterparts with normal renal function<sup>6–8</sup> and increased rates of returning to the operating room,<sup>7–9</sup> but this has only been demonstrated for specific procedures or in small numbers. Here, we chose to look at the most common procedures within a large national database.

The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) is a large, standardized, nationwide surgical database and serves as a valuable resource to study-specific patient populations. Using this database allows us to study a broader range of procedures with a larger population. The objective of this study was to assess the unique complications affecting patients with ESRD on dialysis who undergo several of the most common General Surgery procedures and to determine if there is any increased morbidity and mortality and also the risk factors for returning to the operating room.

## Methods

Exempt status was granted from our institutional review board. Data were extracted from the 2005 to 2010 ACS-NSQIP Participant Use files, which includes 240 demographic, preoperative, operative, morbidity, and mortality variables. Diseases and procedures are classified using the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* and Current Procedural Terminology (CPT) codes.

A frequency plot was used to determine the most common General Surgery procedures identified by CPT codes. Next, we selected for all patients who underwent the 4 most common procedures, including appendectomy, cholecystectomy, ventral hernia repair, and colectomy (CPTs: 44,140, 44,143, 44,145, 44,160, 44,204, 44,205, 44,207, 44,950, 44,955, 44,960, 44,970, 47,562, 47,563, 49,560, 49,561, 49,565, 49,566, 49,568, 49,652, and 49,653) (Table 1). Patients were then excluded based on the following statuses: previous operation in the past 30 days, pregnancy, younger than 16 years, and those who had emergency surgery. Patients with ESRD on hemodialysis were then identified, and a matched cohort was created using SPSS 20.0 fuzzy extension. Patients with ESRD on hemodialysis were one-to-one matched with the control cohort based on age, gender, and procedure type.

Student *t* test was used to compare continuous preoperative and postoperative variables. The chi-square test was used to compare categorical variables for dialysis vs control patients. Multivariate logistic regression was used to analyze the effect of ESRD on mortality, morbidity, and returning to the

**Table 1** Procedure CPT codes

Procedure	CPT codes
Open colectomy	44,140, 44,143, 44,145, 44,160
Laparoscopic colectomy	44,204, 44,205, 44,207
Open cholecystectomy	47,600
Laparoscopic cholecystectomy	47,562, 47,563
Open ventral hernia repair	49,560, 49,561, 49,565, 49,566, 49,568
Laparoscopic ventral hernia repair	49,652, 49,653
Open appendectomy	44,950, 44,955, 44,960
Laparoscopic appendectomy	44,970

CPT = Current Procedural Terminology.

operating room. Complications were grouped into “infectious complications” (eg, sepsis, septic shock, urinary tract infection, and surgical site infection), “pulmonary complications” (pneumonia and respiratory failure), and “vascular complications” (cardiac arrest, myocardial infarction, deep vein thrombosis/pulmonary embolism, and cerebrovascular accident).

The ESRD group was then further stratified into “return to operating room” and “no return to operating room.” The 2 groups were compared in terms of preoperative and surgical profiles. Again, Student *t* test was used to compare continuous preoperative and postoperative variables. The chi-square test was used to compare categorical variables for patients who returned to the operating room vs those who did not. Multivariate logistic regression analysis was performed to analyze the effect of returning to the operating room on postoperative mortality and morbidity in patients with ESRD. All statistics and cohort creation were completed using IBM SPSS Statistics 20 (Armonk, NY), and *P* value of .05 was set for statistical significance.

## Results

The ACS-NSQIP database was analyzed for the most common General Surgery procedures, with the top 4 identified as colectomy, appendectomy, cholecystectomy, and ventral hernia repair. A total of 195,585 patients underwent the described procedures and fit the inclusion criteria, of which 1,163 were patients with ESRD undergoing hemodialysis at the time of surgery. These 1,163 patients were matched with controls.

We found that ESRD was associated with a significantly increased 30-day mortality (odds ratio [OR] 9.05, 95% confidence interval [CI] 4.09 to 20.00) (Table 2). Patients with ESRD had increased rates of infectious, vascular, and pulmonary complications after surgery (OR 1.35, CI 1.02 to 1.79; OR 3.41, CI 1.96 to 5.94; and OR 3.07, CI 2.01 to 4.70, respectively) (Table 2). Finally, patients with ESRD undergoing hemodialysis were nearly 3 times as likely to return to the operating room (OR 2.97, CI 1.99 to 4.46).

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