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# Fluid administration and morbidity in transhiatal esophagectomy



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## ABSTRACT

**Background:** Esophagectomy is associated with significant morbidity. Optimizing perioperative fluid administration is one potential strategy to mitigate morbidity. We sought to investigate the relationship of intraoperative fluid (IOF) administration to outcomes in patients undergoing transhiatal esophagectomy with particular attention to malnourished patients, who may be more susceptible to the effects of fluid overload.

**Material and methods:** Patients who underwent transhiatal esophagectomy from 2000–2013 were identified from a retrospective database. IOF rates (mL/kg/hr) were determined and their relationship to outcomes compared. To examine the impact of malnutrition, we stratified patients based on median preoperative serum albumin and compared outcomes. **Results and discussion:** 211 patients comprised the cohort. 74% of patients underwent esophagectomy for esophageal adenocarcinoma. Linear regression analyses were performed comparing independent perioperative variables to four outcomes variables: length of stay, complications per patient, major complications, and Clavien-Dindo classification. IOF rate was significantly associated with three of four outcomes on univariate analysis. Significantly more patients with a preoperative albumin level  $\leq 3.7$  g/dL who received more than the median IOF rate experienced more severe complications.

**Conclusions:** Increased intraoperative fluid administration is associated with perioperative morbidity in patients undergoing transhiatal esophagectomy. Patients with lower preoperative albumin levels may be particularly sensitive to the effects of volume overload.

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## 1. Introduction

Esophagectomy is a procedure associated with significant morbidity and mortality. Pulmonary complications and anastomotic leak rates are frequently reported, with morbidity and mortality rates approaching 50% and 10% respectively in large patient cohorts [1,2]. Strategies to

minimize morbidity have focused on improving patient selection through the development of preoperative scoring systems based on risk factors identified from retrospective analyses of esophagectomies [3,4]. Another approach has been to improve perioperative care. Recently, the implementation of standardized perioperative and multidisciplinary care pathways in esophageal carcinoma patients has

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been associated with decreased lengths of hospital stay [5]. One aspect of such pathways includes the standardization of perioperative fluid management. Both prospective and retrospective studies in colorectal and pancreatic surgery have demonstrated that fluid restrictive practices (or the avoidance of volume overload) are associated with improved perioperative outcomes [6–12].

Liberal perioperative fluid administration can lead to fluid overload, which has negative consequences on a number of organ systems including cardiopulmonary, gastrointestinal, and renal complications [6,9,13]. Likewise, preoperative factors such as malnutrition, reflected by hypoalbuminemia, are associated with morbidity in major abdominal surgery [14]. Hypoalbuminemia leads to greater intravascular volume loss during periods of fluid administration and can thus exacerbate the negative consequences of volume overload. We demonstrated this in patients undergoing pancreaticoduodenectomy at our institution, in which hypoalbuminemic patients who received a greater intraoperative fluid rate experienced more severe complications [10].

The association between fluid administration and perioperative outcomes in esophagectomy has been limited primarily to transthoracic esophagectomy (TTE). These studies report an association of perioperative fluid administration with a number of complications, particularly respiratory [5,15–17]. Compared to TTE, transhiatal esophagectomy (THE) is associated with shorter operative times and length of stay, but similar blood loss. TTE patients experience more respiratory complications and wound infections, while THE patients experience more anastomotic leaks and strictures [18]. Given the technical differences in these procedures and their differences in complication profiles, we sought to investigate the relationship of intraoperative fluid administration to perioperative outcomes in patients undergoing transhiatal esophagectomy.

## 2. Methods

A retrospective analysis was performed based on data from an institutional review board-approved, retrospectively acquired database at Robert Wood Johnson University Hospital (New Brunswick, NJ). Patients who underwent transhiatal esophagectomy from 2000–2013 with complete data on intraoperative fluid administration were identified. All patients underwent concurrent placement of a feeding jejunostomy for postoperative enteral nutrition. Each surgery was performed by two attending surgeons: a surgical oncologist and a thoracic surgeon. Anesthetic approaches to fluid resuscitation and blood loss were not standardized, although typically blood was replaced with crystalloid and colloid at 3:1 and 1:1 ratios respectively.

Collected data included preoperative patient demographics, co-morbidities, intraoperative variables (fluid administration, transfusion of blood products, estimated blood loss, operative time), and postoperative outcomes. Intraoperative fluid (IOF) administration was determined by combining administered crystalloid, colloid, and blood products based on anesthesia records and analyzed as a fluid rate (mL/kg/hr), as we have previously demonstrated [10]. We used intraoperative fluid rates for analyses rather than total fluid

volumes because it allowed us to control for differences in patient weight and operative time, which are two variables that can impact total fluid volumes. Postoperative outcomes analyzed included mortality, complications per patient, complication severity (Clavien-Dindo classification), and length of stay [19].

We stratified the entire cohort by median IOF rate and conducted Student's t-tests, chi-squared tests, and Wilcoxon-Mann-Whitney rank sum tests for appropriate variables (continuous, ordinal, etc.). This analysis was also performed in subgroups stratified by median preoperative serum albumin level (3.7 g/dL). Univariate and multivariate logistic regression analyses of perioperative variables were conducted on the aforementioned postoperative outcomes. Statistical significance was accepted at a P-value  $\leq 0.05$ .

## 3. Results

From February 2000 to November 2013, a total of 211 patients underwent transhiatal esophagectomy, with their demographics shown in Table 1. In the patient cohort, 177 (84%) were male, and the median age was 63 (range 40–82). 125 (59%) patients received neoadjuvant therapy, 111 (89%) of whom underwent chemotherapy and radiation. 153 (73%) patients underwent esophagectomy for esophageal adenocarcinoma. Table 2 shows perioperative outcomes. Median IOF rate was 17.26 mL/kg/hr. Median length of stay was 9 days (range 5–107). Median perioperative Clavien-Dindo classification was 2, with the mean number of complications per patient 1.3. The anastomotic leak rate was 17.5%. 93 (44%) patients experienced major complications (Clavien-Dindo classification 3–5). One patient in the cohort experienced an intraoperative mortality (0.5%). There were no postoperative mortalities at 30 days.

When stratifying patients by the median IOF rate of 17.26 mL/kg/hr, 39/105 (37%) patients in the lower IOF rate cohort experienced major complications, while this

**Table 1 – Patient demographics. DM (diabetes mellitus), HTN (hypertension), CAD (coronary artery disease, COPD (chronic obstructive pulmonary disease).**

N	211
Median age, y (range)	63 (40–82)
Male, n (%)	177 (83.9)
Past medical history, n (%)	
DM	32 (15.2)
HTN	98 (46.5)
CAD	43 (20.4)
COPD	14 (6.6)
History of smoking	156 (73.9)
Diagnosis	3 (0–3)
Adenocarcinoma	153 (72.5)
Squamous cell carcinoma	27 (12.8)
Other	31 (14.7)
Median co-morbidity index, ASA score (range)	3 (1–4)
Mean preoperative weight, kg (SD)	83.5 (22.2)
Median preoperative serum albumin, g/dL (SD)	3.7 (0.45)
Neoadjuvant therapy, n (%)	125 (59.2)

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