# Comparison of albumin and crystalloid fluids for the management of perioperative volume resuscitation in esophagectomy

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## Background

Esophagectomies are complex, high-risk procedures associated with significant morbidity and mortality. The 30-day postoperative mortality rates range between 3 and 25%.[1] Anastomotic leaks are communication failures between the esophageal segment and newly formed surgical connection, possibly leading to severe infection and death.[2] Anastomotic leak rates range from 6.6% to 17.2%.[3] Existing literature supporting the use of colloids over crystalloids for the management of perioperative volume resuscitation in esophagectomy is limited.

## Objectives

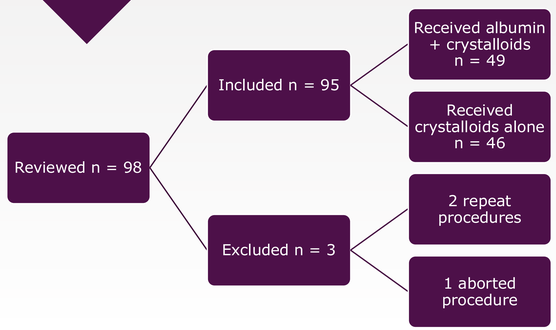
To evaluate differences in morbidity, mortality, and need for further intervention between patients who received albumin solution or crystalloid fluid for volume resuscitation during esophagectomy.

## Methods

**Design**
- IRB-approved, multisite, retrospective chart review

**Time frames**
- UPMC Mercy: 8/24/2020 - 12/11/2023
- UPMC Passavant: 8/26/2021 - 12/4/2023

**Inclusion criteria**
- Age ≥ 18 years
- First esophagectomy
- Received albumin solution or crystalloid fluids perioperatively




## Results

### Table 1. Baseline Characteristics

| | Albumin & crystalloids (n = 49) | Crystalloids alone (n = 46) | P-value |
|---|---|---|---|
| **Hospital** | | | 0.21 |
| Mercy, n (%) | 21 (42.9%) | 14 (30.4%) | |
| Passavant, n (%) | 28 (57.1%) | 32 (69.6%) | |
| **Age, years** | | | |
| Mean (SD) | 63.7 (9.3) | 63.3 (9.9) | 0.86 |
| **Male sex, n (%)** | 38 (77.6%) | 35 (76.1%) | 0.87 |
| **BMI, kg/m²** | | | |
| Mean (SD) | 27.2 (6.3) | 26.5 (0.9) | 0.58 |
| **Serum creatinine, mg/dL** | | | |
| Mean (SD) | 0.82 (0.21) | 0.83 (0.25) | 0.80 |
| **Serum albumin, g/dL** | | | |
| Mean (SD) | 2.9 (0.55) Missing = 25 (51.0%) | 2.6 (0.75) Missing = 28 (60.9%) | 0.22 |
| **Prior chemotherapy, n (%)** | 32 (65.3%) | 31 (67.4%) | 0.83 |
| **Prior radiation therapy, n (%)** | 29 (59.2%) | 24 (52.2%) | 0.49 |
| **Prior respiratory comorbidity, n (%)** | | | |
| Smoking history | 32 (65.3%) | 32 (69.6%) | 0.66 |
| Asthma | 5 (10.2%) | 3 (6.5%) | 0.72 |
| COPD | 8 (16.3%) | 8 (17.4%) | 0.89 |
| Baseline oxygen | 4 (8.2%) | 3 (6.5%) | 1 |
| **Prior volume disorder, n (%)** | | | |
| Heart failure | 3 (6.1%) | 2 (4.3%) | 1 |
| Cirrhosis | 0 (0%) | 3 (6.5%) | 0.11 |
| CKD | 4 (8.2%) | 5 (10.9%) | 0.74 |
| **ASA Physical Status Classification (I – VI), n (%)** | | | 0.2 |
| I | 0 (0%) | 0 (0%) | |
| II | 4 (8.2%) | 1 (2.2%) | |
| III | 44 (89.8%) | 41 (89.1%) | |
| IV | 1 (2.0%) | 4 (8.7%) | |
| V | 0 (0%) | 0 (0%) | |
| VI | 0 (0%) | 0 (0%) | |

### Table 2. Outcomes

| | Albumin & crystalloids (n = 49) | Crystalloids alone (n = 46) | P-value |
|---|---|---|---|
| **Primary Outcome** | | | |
| **Anastomotic leak rate, n (%)** | 6 (12.2%) | 9 (19.6%) | 0.33 |
| **Secondary Outcomes** | | | |
| **In-hospital mortality rate, n (%)** | 1 (2.0%) | 1 (2.2%) | 1 |
| **Hospital length of stay, days** | | | |
| Median (IQR) | 9.4 (8.4-15.3) | 10.5 (8.5-15.9) | 0.30 |
| **Length of surgery, minutes** | | | |
| Median (IQR) | 575 (522-621) | 610 (533-660) | 0.14 |
| **Ventilator requirements, days** | | | |
| Median (IQR) | 0.58 (0.5-0.66) | 0.63 (0.58-0.74) | 0.10 |
| **Intra-op hypotension, n (%)** | 35 (71.4%) | 33 (71.7%) | 0.97 |
| **Intra-op fluid volume, L** | | | |
| Mean (SD) | 7.2 (1.4) | 7.4 (1.6) | 0.66 |
| **Post-op fluid volume, L** | | | |
| Mean (SD) | 7.2 (4) | 6.5 (2) | 0.31 |
| **Post-op AKI rate, n (%)** | 4 (8.2%) | 3 (6.5%) | 1 |
| **Intra-op vasopressor push doses, n (%)** | 25 (51.0%) | 21 (45.7%) | 0.60 |
| **Total peri-op vasopressor infusion time, hours** | | | |
| Mean (SD) | 0 | 1.5 (10.6) | 0.32 |
| Median (IQR) | 0 (0-0) | 0 (0-0) | 0.31 |
| **Post-op loop push doses, n (%)** | 10 (20.4%) | 5 (10.9%) | 0.20 |

There was no difference in the rate of anastomotic leak between cohorts, with 6 patients in the albumin group and 9 in the crystalloids alone group experiencing a leak (12.2% vs 19.6%, P = 0.33). One patient died in each group (P = 1), and there was no difference in LOS between albumin and crystalloid groups (9.4 vs 10.5 days, P = 0.30).

There was also no difference between any of the other secondary outcomes including total peri-op fluid, post-op CRRT rate, intra-op vasopressor infusion, total peri-op loop diuretic push doses, total peri-op furosemide equivalents.

## Discussion

This is one of the first studies to compare outcomes between volume resuscitation management strategies in esophagectomy. We were unable to detect differences between patients receiving albumin with or without crystalloid vs crystalloids alone for fluid resuscitation.

One meta-analysis including surgical patients from 23 trials demonstrated no mortality benefit between seven fluid resuscitation strategies. However, this analysis included studies from as far back as 1979 and included resuscitation with hetastarch and gelatin, products that are rarely used today.[4] Although this meta-analysis included patients who received several different types of surgery, no patient underwent esophagectomy.[4]

Walsh et al. compared rates of anastomotic leak after esophagectomy and found that the use of vasopressors and fluid volume were not associated with an increased risk of anastomotic leak.[5] However, they reported using both colloids and crystalloids. This is the first study to our knowledge that compared rates of anastomotic leak based on fluid selection, and we were unable to demonstrate benefit. We also found no difference in the incidence of hypotension, need for vasopressors or loop diuretics, LOS, or mortality, suggesting that fluid selection may be less important on outcomes than theorized.

The primary limitation was the small sample size and event rate, contributing to the possibility of a type II error. Other limitations include inconsistent documentation. Data were missing for more than 50% of the serum albumin levels at baseline, limiting our ability to assess nutritional status. However, despite missing values, there was no difference in baseline albumin levels between groups (p=0.22). We also did not collect the administration of blood products or the specific type or volume of crystalloid fluid that each patient received. In the albumin group, we recorded the total volume that each patient received, both intra-operatively and post operatively, but did not specifically record how much of the volume was albumin. However, the mean volume administered between groups did not differ intra-operatively (p=0.66) or post-operatively (p=0.31). Finally, there was an inability to access death records beyond hospitalization.

Strengths of this study include that this was a multi-site study, and all patients underwent esophagectomy by minimally invasive Ivor-Lewis technique. Another strength was the comparable baseline characteristics between cohorts. This is a novel study in an area of relevance, given significant shortages and potential cost-savings.

## Conclusion

No statistical differences in anastomotic leak, in-hospital mortality, or other complications were identified in patients undergoing esophagectomy managed with or without albumin. Additional prospective studies are needed to confirm these findings.

## References

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