Can J Anesth/J Can Anesth (2022) 69:1099–1106
https://doi.org/10.1007/s12630-022-02280-7

REPORTS OF ORIGINAL INVESTIGATIONS

The impact of hypoalbuminemia on postoperative outcomes after outpatient surgery: a national analysis of the NSQIP database

Impact de l'hypoalbuminémie sur les issues postopératoires après chirurgie ambulatoire : une analyse nationale de la base de données NSQIP

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Received: 22 September 2021 / Revised: 15 March 2022 / Accepted: 27 March 2022 / Published online: 27 June 2022

Abstract

Purpose *Hypoalbuminemia has been described as a modifiable factor to optimize postoperative outcomes after major inpatient surgeries. Nevertheless, the role of hypoalbuminemia on outpatient procedures is not well defined. The purpose of this study was to examine the impact of hypoalbuminemia on postoperative outcomes of patients undergoing low-risk outpatient surgery.*

Methods *Patients were extracted from the American College of Surgeons National Surgical Quality Improvement Program database who had outpatient surgery from 2018 and recorded preoperative albumin levels. The primary outcome was a composite of any major complications including: 1) unplanned intubation, 2) pulmonary embolism, 3) ventilator use > 48 hr, 4) progressive renal failure, 5) acute renal failure, 6) stroke/cerebrovascular accident, 7) cardiac arrest, 8) myocardial infarction, 9) sepsis, 10) septic shock, 11) deep venous thrombosis, and 12) transfusion. Death, any infection, and readmissions were secondary outcomes.*

Results *A total of 65,192 (21%) surgical outpatients had albumin collected preoperatively and 3,704 (1.2%) patients had levels below 3.5 g·dL^{-1}. In the albumin cohort, 394/65,192 (0.6%) patients had a major medical complication and 68/65,192 (0.1%) patients died within 30 days after surgery. Albumin values < 3.5 g·dL^{-1} were associated with major complications (adjusted odds ratio [aOR], 1.92; 95% confidence interval [CI], 1.44 to 2.57; P < 0.001; death-adjusted OR, 3.03; 95% CI, 1.72 to 5.34; P < 0.001); any infection (aOR, 1.49; 95% CI, 1.23 to 1.82; P < 0.001); and readmissions (aOR, 1.82; 95% CI, 1.56 to 2.14; P < 0.001). In addition, when evaluated as a continuous variable in a multivariate analysis, for each increase in albumin of 0.10 g·dL^{-1}, there was an associated reduction of major complications (aOR, 0.94; 95% CI, 0.92 to 0.96; P < 0.001).*

Conclusions *Hypoalbuminemia is associated with major complications and death in outpatient surgery. Since hypoalbuminemia is a potential modifiable intervention, future clinical trials to evaluate the impact of optimizing preoperative albumin levels before outpatient surgery are warranted.*

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12630-022-02280-7.

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Résumé

Objectif *L'hypoalbuminémie a été décrite comme un facteur modifiable pour optimiser les issues postopératoires après des chirurgies hospitalières majeures. Néanmoins, le rôle de l'hypoalbuminémie dans les interventions ambulatoires n'est pas bien défini. L'objectif de cette étude était d'examiner l'impact de* *l'hypoalbuminémie sur les issues postopératoires des patients bénéficiant d'une chirurgie ambulatoire à faible risque.*

Méthode *Les patients ayant bénéficié d'une chirurgie ambulatoire à partir de 2018 et pour lesquels les taux d'albumine préopératoire ont été enregistrés ont été extraits de la base de données américaine du programme national d'amélioration de la qualité chirurgicale (NSQIP) de l'American College of Surgeons. Le critère d'évaluation principal était un composite de toutes les complications majeures, y compris : 1) intubation non planifiée, 2) embolie pulmonaire, 3) utilisation d'un ventilateur > 48 h, 4) insuffisance rénale progressive, 5) insuffisance rénale aiguë, 6) accident vasculaire cérébral, 7) arrêt cardiaque, 8) infarctus du myocarde, 9) sepsis, 10) choc septique, 11) thrombose veineuse profonde, et 12) transfusion. Les décès, infections et réadmissions constituaient des critères d'évaluation secondaires.*

Résultats *Au total, les taux d'albumine ont été prélevés chez 65 192 (21 %) patients chirurgicaux ambulatoires avant l'opération et 3704 (1,2 %) patients avaient des taux inférieurs à 3,5 g·dL^{-1}. Dans la cohorte albumine, 394 / 65 192 (0,6 %) patients ont eu une complication médicale majeure et 68 / 65 192 (0,1%) patients sont décédés dans les 30 jours suivant la chirurgie. Des valeurs d'albumine < 3,5 g·dL^{-1} étaient associées à des complications majeures (rapport de cotes ajusté [RCA]), 1,92 ; intervalle de confiance [IC] à 95 %, 1,44 à 2,57; P < 0,001; RC ajusté en fonction du décès, 3,03; IC 95 %, 1,72 à 5,34; P < 0,001); infections (RCA, 1,49; IC 95 %, 1,23 à 1,82; P < 0,001); et réadmissions (RCA, 1,82; IC 95 %, 1,56 à 2,14; P < 0,001). De plus, lorsque le taux d'albumine était évalué comme variable continue dans une analyse multivariée, pour chaque augmentation de l'albumine de 0,10 g·dL^{-1}, il y avait une réduction associée des complications majeures (RCA, 0,94; IC 95 %, 0,92 à 0,96; P < 0,001).*

Conclusion *L'hypoalbuminémie est associée à des complications majeures et au décès en chirurgie ambulatoire. Étant donné que l'hypoalbuminémie est une intervention potentiellement modifiable, de futures études cliniques visant à évaluer l'impact de l'optimisation des taux préopératoires d'albumine avant une chirurgie ambulatoire sont nécessaires.*

Keywords hypoalbuminemia · NSQIP · nutrition · outpatient surgery · postoperative outcomes

Outpatient surgeries continue to grow as a percentage of elective surgical procedures.[1] They provide the following advantages to both patients and institutions: 1) reduced costs, 2) faster recoveries, and 3) better convenience for patients.[2,3] To safely perform these procedures, patient selection has been a cornerstone for successful outcomes.[4] Younger, healthier patients were the first to be referred to ambulatory surgical centres, but this trend has been gradually expanded to include patients with increasing numbers of comorbidities.[5] In addition, more complex and invasive procedures with greater risks are being shifted to the outpatient setting.[3,4]

Patient optimization prior to surgery has become increasingly important to allow more complex surgeries and sicker patients in the outpatient setting.[6] It has previously been noted that hypoalbuminemia is a potential modifiable factor affecting postoperative outcomes after major inpatient surgeries.[6–9] Synthesized by the liver and excreted into the bloodstream, albumin maintains the plasma osmotic pressure, neutralizes toxins, and transports various ligands throughout the circulatory system. Low levels of albumin are mainly due to increased vascular permeability in cells resulting in redistribution of intravascular and extravascular volume. Events such as inflammation or disease conditions that decrease albumin synthesis (liver disease) or increase excretion of albumin in the urine (nephrosis) or intestine (intestinal pathology) are known to be strongly correlated with low albumin levels. Patients who are malnourished may experience low serum levels of albumin, which has been linked to adverse events in the postoperative period. The impact of hypoalbuminemia on postoperative outcomes after lower risk outpatient surgeries is not well defined. This gap in knowledge is particularly important for elective outpatient surgeries as albumin levels can be preoperatively optimized.

The main objective of this study was to evaluate major postoperative complications between patients who had albumin levels greater than or equal to 3.5 g·dL^{-1} and less than 3.5 g·dL^{-1}. A measure of < 3.5 g·dL^{-1} is clinically used to define hypoalbuminemia. We hypothesized that there would be different odds of major 30-day postsurgical complications between patients with normal albuminemia (serum albumin level $\geq$ 3.5 g·dL^{-1}) and hypoalbuminemia (serum albumin level < 3.5 g·dL^{-1}). We also sought to evaluate the association between albumin levels and readmissions.

Methods

This study was performed under an exempt status granted by the Institutional Review Board (IRB) of Lifespan (Providence, RI, USA; IRB#1789448). The IRB determined that the study qualified for exemption under

45 CFR 46.191(b). Clinical information of the participants was obtained from the American College of Surgeons National Surgical Quality Improvement (ACS-NSQIP) database. The study is reported following the STROBE guidelines for reporting observational studies.[10]

The ACS-NSQIP database is a national prospective database that complies voluntarily reported data from over seven hundred institutions in the USA. Over one million cases were added to the 2018 database. Data are collected on over three hundred variables, including intraoperative risk factors, intraoperative variables, and postoperative outcomes including complications up to 30 days post procedure. Trained clinical staff at each site collect data for 30 days after a procedure using isolated telephone interviews as well as operative and clinical notes. The combined results of these audits completed to date revealed an overall interrater disagreement rate of approximately 1.8% for all assessed variables. More details about the database have been previously described.[11]

For the current investigation, the 2018 NSQIP Participant Use Data Files were queried to extract all patients who underwent outpatient surgery, defined as length of stay (LOS) of 0 days. Patients with an American Society of Anesthesiologists (ASA) Physical Status classification of IV or V were excluded as these patients are not routinely treated in the outpatient setting. We also excluded emergency and elective surgeries, and patients younger than 18 yr.

Primary explanatory and outcome variables

Serum albumin level collected within three weeks prior to the procedure was the primary independent variable of interest and it was categorized as low (serum albumin level < 3.5 g·dL^{-1}) or normal (serum albumin level ≥ 3.5 g·dL^{-1}).

The primary outcome was a composite of any major complications that were previously used in other NSQIP studies,[12–17] including: 1) unplanned intubation, 2) pulmonary embolism, 3) ventilator use > 48 hr, 4) progressive renal failure, 5) acute renal failure, 6) stroke/cerebrovascular accident, 7) cardiac arrest, 8) myocardial infarction, 9) sepsis, 10) septic shock, 11) deep venous thrombosis, and 12) transfusion.

Secondary outcomes included a composite outcome for any infection, including: 1) superficial wound infection, 2) deep incisional wound infection, 3) organ space wound infection, 4) surgical wound disruption, 5) pneumonia, 6) urinary tract infection, 7) sepsis, and 8) septic shock. We also examined 30-day mortality and 30-day readmissions as secondary outcomes.

Statistical analysis

We compared preoperative demographics, clinical characteristics, and comorbidities between the low serum albumin level (serum albumin level < 3.5 g·dL^{-1}) or normal serum albumin level (serum albumin level $\geq$ 3.5 g·dL^{-1}) groups. Categorical variables are reported as counts and percentages, and continuous variables as mean and standard deviation or medians and interquartile range as appropriate. Continuous variables were assessed for normality and analyzed using unpaired Student's t test or Wilcoxon rank sum, as appropriate. Categorical variables were analyzed with Chi square tests.

The primary and secondary endpoints were analyzed with multivariate logistic regression models. For each endpoint, a multivariate logistic regression analysis was used to evaluate the association with albumin level (< 3.5 g·dL^{-1} *vs* $\geq$ 3.5 g·dL^{-1}) while adjusting for potential confounding by pre-existing comorbidities and other patient factors. Preidentified variables that are clinically relevant as potential confounders for outcomes after outpatient surgery were included in each multivariate logistic regression model (age, sex, body mass index [BMI], ASA Physical Status classification, race, estimated probability of morbidity, and estimated probability of mortality).[12] Variables included in the multivariate models were assessed for intercorrelation prior to modelling, and none of the correlations between pairs of variables exceeded 0.40. Adjusted odds ratios (ORs), 95% confidence intervals (CIs), and P values are reported. We evaluated the predictive ability and adequacy of each model using the c-statistic (area under the receiver operating characteristic curve).

Prior to multivariate analysis, missing preoperative data were imputed through multiple imputation. Missing preoperative data were examined and as there were systemic differences between patients with missing data and those with complete data, we determined that the data were not missing completely at random and preceded with multiple imputation. The fully conditional specification method was used to impute 15 data sets. Multivariate analyses were conducted on a multiply imputed data set. Imputed values were not used for descriptive data shown in Table 1.

As an additional analysis on the primary endpoint of any major complication, albumin level was considered as a continuous variable. In this analysis, the OR represents the increase in odds for each 0.10 g·dL^{-1} unit increase in albumin level. Results were adjusted for age, sex, BMI, ASA classification, race, estimated probability of morbidity, and estimated probability of mortality. Additionally, we used a restricted cubic spline plot to explore the shape of the association between albumin level

Table 1 Demographics and clinical characteristics

	All Patients (N = 65,192)	Albumin $\geq$ 3.5 g·dL^{-1} (N = 61,488)	Albumin < 3.5 g·dL^{-1} (N = 3,704)	Difference (95% CI)	P value
Age (yr), mean (SD)	54.9 (15.8)	54.8 (15.7)	58.0 (16.7)	-3.25 (-3.80 to -2.70)	< 0.001
Female, *n*/total *N* (%)	38,527/65,192 (59.1%)	36,249/61,488 (58.9%)	2,278/3,704 (61.5%)	-2.55 (-4.16 to -0.93)	0.002
BMI (kg·m^{-2}), mean (SD) [*n*]	30.5 (7.1) [64,907]	30.4 (7.0) [61,217]	31.7 (8.6) [3,690]	-1.25 (-1.53 to -0.97)	< 0.001
ASA Physical Status, *n*/total *N* (%)					< 0.001
ASA I	5,345/65,192 (8.20%)	5,225/61,488 (8.5%)	120/3,704 (3.2%)	5.26 (4.65 to 5.87)	< 0.001
ASA II	35,810/65,192 (54.9%)	34,488/61,488 (56.1%)	1,322/3,704 (35.7%)	20.4 (18.81 to 21.99)	< 0.001
ASA III	24,037/65,192 (36.9%)	21,775/61,488 (35.4%)	2,262/3,704 (61.1%)	-25.7 (-27.27 to -24.04)	< 0.001
Race, *n*/total *N* (%)					< 0.001
White	49,188/58,507 (84.1%)	46,498/55,141 (84.3%)	2,690/3,366 (79.9%)	4.41 (3.02 to 5.80)	< 0.001
Black	6,648/58,507 (11.4%)	6,094/55,141 (11.1%)	554/3,366 (16.5%)	-5.41 (-6.69 to -4.13)	< 0.001
Asian	2,116/58,507 (3.6%)	2,034/55,141 (3.7%)	82/3,366 (2.4%)	1.25 (0.71 to 1.80)	< 0.001
Other	555/58,507 (0.95%)	515/55,141 (0.9%)	40/3,366 (1.2%)	-0.25 (-0.63 to 0.12)	0.14
Estimated probability of mortality, mean (SD)	0.08 (0.23)	0.07 (0.16)	0.29 (0.65)	-0.22 (-0.24 to -0.20)	< 0.001
Estimated probability of morbidity, mean (SD)	1.97 (1.58)	1.89 (1.48)	3.17 (2.46)	-1.28 (-1.36 to -1.20)	< 0.001

Data presented as *n*/total *N* (%) unless otherwise stated. Unpaired Student's *t* test or the Wilcoxon rank sum test was used for continuous variables. The Chi square test was used for categorical variables. Denominators that do not equal the sample sizes are due to missing data. If no denominator is given, all data were present.

ASA = American Society of Anesthesiologists; BMI = body mass index; SD = standard deviation

and the primary outcome. Restricted cubic spline analysis is an alternative to categorizing a continuous variable or imposing the assumption of a linear association on a continuous variable. In this analysis, five knots were placed at the 5th, 27.5th, 50th, 72.5th, and 95th percentiles. Adjusted results are presented. Lastly, we performed a subgroup analysis by excluding diseases that can cause hypoalbuminemia (e.g., ascites, malignancy, international normalized ratio [INR] > 1.4) to check if the results would remain significant.

A P value of < 0.05 was used for significance for the primary outcome. To maintain a type I error of 0.05 across three secondary outcomes, Bonferroni corrections were used and statistical significance was set at 0.017 for each secondary outcome. All P values are two-sided. All statistical analyses were conducted using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

The NSQIP database included a total of 331,567 patients who underwent outpatient procedures in 2018. After exclusions, a total of 65,192 were identified as part of the albumin cohort, of which 3,704 had a serum albumin level < 3.5 g·dL^{-1} (Figure 1). Baseline demographic and comorbidities are presented in Table 1. Patients with albumin < 3.5 g·dL^{-1} were older, had a higher BMI, were more likely to be female and Black, and had a greater rate of ASA Physical Status III classification compared with patients with preoperative albumin levels $\geq$ 3.5 g·dL^{-1}.

In the albumin cohort, 394/65,192 (0.6%) patients had a major medical complication, 1,577 (2.4%) were readmitted, 68 (0.1%) died, and 1,182 (1.8%) had an infection within 30 days after surgery. In the multivariate analysis, there was an association between patients with albumin levels < 3.5 g·dL^{-1} and major complications (OR 1.92; 95% CI, 1.44 to 2.57; P < 0.001), readmission (OR, 1.82; 95% CI, 1.56 to 2.14; P < 0.001), any infection (OR, 1.49; 95% CI, 1.23 to 1.82; P < 0.001), and death (OR, 3.03; 95% CI, 1.72 to 5.34; P < 0.001) (Table 2). The unadjusted and adjusted analyses of the covariates used in the regression model are presented in Electronic Supplementary Material (ESM) eTable.

When evaluated as a continuous variable in a multivariate analysis, albumin (per 0.10 g·dL^{-1} increase) was still associated with any major complication (OR, 0.94; 95% CI, 0.92 to 0.96; P < 0.001; C statistic = 0.72). In addition, a restricted cubic spline plot was used to explore the shape of the association between albumin level and the primary outcome, showing a similar discriminant property as the continuous linear analysis (ESM, eFigure).

Lastly, a subgroup analysis excluding patients (1,080 patients with albumin $\geq$ 3.5 g·dL^{-1}; 294 patients with

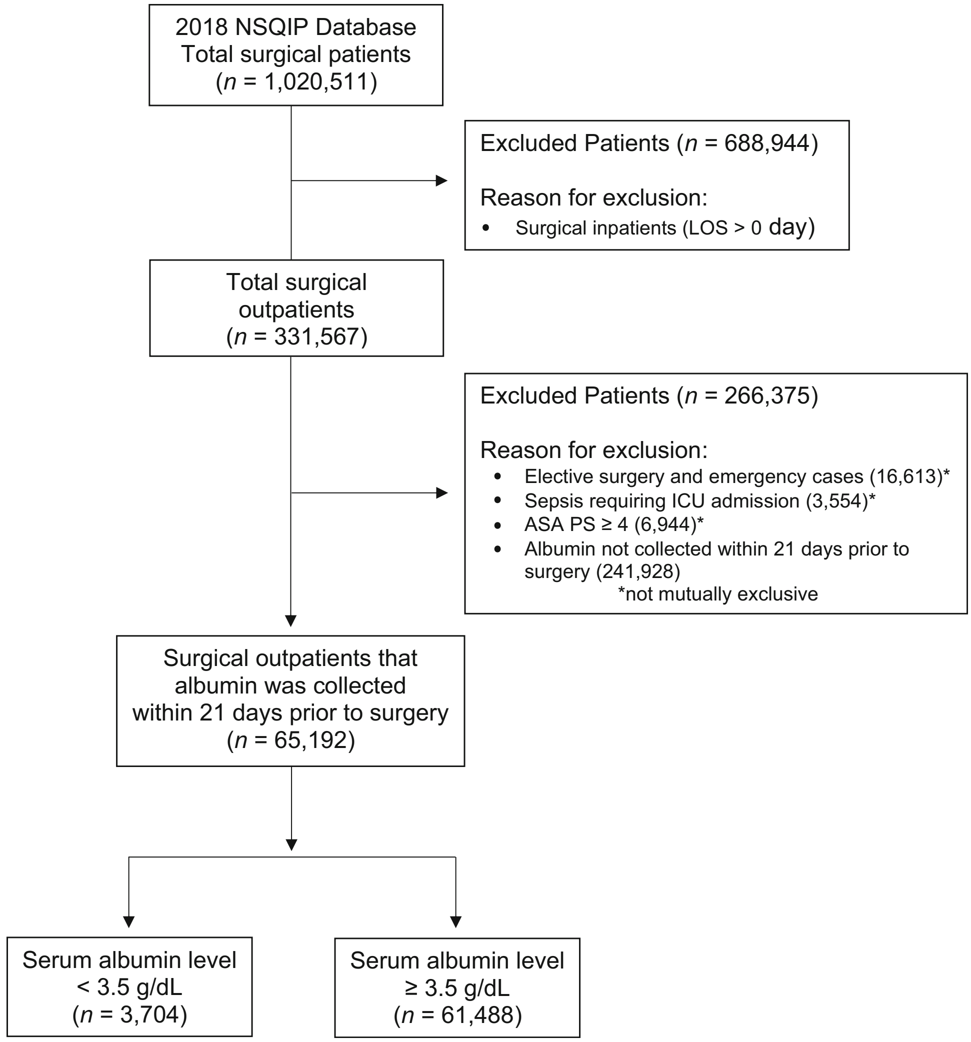

Figure 1 Study flow diagram

Table 2 Unadjusted and adjusted analyses for 30-day postsurgical complications outcomes between patients who had albumin levels < 3.5 g·dL^{-1} compared with patients who had albumin levels ≥ 3.5 g·dL^{-1} within three weeks prior to surgery

Outcomes	Unadjusted			Adjusted		
	Albumin < 3.5 g·dL^{-1} N = 3,704	Albumin $\geq$ = 3.5 g·dL^{-1} N = 61,488	Difference (95% CI)	Odds ratio (95% CI)	P value	C statistic
Death, *n*/total *N* (%)	25/3,704 (0.7%)	43/61,488 (0.07%)	0.61 (0.34 to 0.87)	3.03 (1.72 to 5.34)	< 0.001	0.91
Any infection, *n*/total *N* (%)	130/3,704 (3.5%)	1,052/61,488 (1.7%)	1.80 (1.20 to 2.40)	1.49 (1.23 to 1.82)	< 0.001	0.66
Readmission, *n*/total *N* (%)	222/3,704 (5.9%)	1,355/61,488 (2.2%)	3.79 (3.02 to 4.56)	1.82 (1.56 to 2.14)	< 0.001	0.67
Any major complication, *n*/total *N* (%)	65/3,704 (1.7%)	329/61,488 (0.5%)	1.22 (0.79 to 1.65)	1.92 (1.44 to 2.57)	< 0.001	0.71

Data presented as *n*/total *N* (%) unless otherwise stated. The risk difference was calculated by subtracting the difference between groups. The 95% CI of the difference is the difference ± the margin of error. Adjusted results are from multivariate logistic regression modelling, adjusting for age, sex, body mass index, race (White as reference), American Society of Anesthesiologists Physical Status classification (III as reference), estimated probability of morbidity, and estimated probability of mortality

CI = confidence interval

albumin < 3.5 g·dL^{-1}) with disseminated cancer, ascites, or INR > 1.4 still detected a significant association between albumin < 3.5 g·dL^{-1} and any major complication (OR, 1.73; 95% CI, 1.24 to 2.41; P = 0.001), readmission (OR, 1.75; 95% CI, 1.47 to 2.08; P < 0.001), any infection (OR, 1.52; 95% CI, 1.24 to 1.87; P < 0.001), but not death (OR, 1.83; 95% CI, 0.86 to 3.89; P = 0.11) (Table 3).

Discussion

The most important finding of the current investigation is the independent association of hypoalbuminemia and an increased risk of major morbidity and death in patients undergoing low-risk outpatient procedures. Patients with albumin levels < 3.5 g·dL^{-1} had a threefold higher odds of death than patients with albumin levels ≥ 3.5 g·dL^{-1} did. In addition, hypoalbuminemia was independently associated with major complications, infections, and readmissions. In fact, looked at as a continuous spectrum rather than just as a cutoff of 3.5 g·dL^{-1}, each 0.1 g·dL^{-1} decrease in albumin increased the chance of major complications. Even after excluding conditions that would further decrease albumin levels—such as ascites, cancer, and elevated INR—readmissions and infections remained elevated compared with the healthier population. Taken together, our results suggest hypoalbuminemia is an independent risk factor for postoperative morbidity and mortality.

Our results are clinically important as programs to optimize preoperative nutrition (e.g., stronger for surgery) have been advocated primarily for more invasive and complex procedures.[18–20] Albumin levels have been evaluated in the areas of oncologic, hepatic, and orthopedic surgical literature and were found to be a marker of surgical complications. For example, a small case-match study investigating preoperative optimization with enteral nutrition given two weeks prior to surgery for Crohn's disease reported a decrease in the overall incidence of postoperative complications.[21] Nevertheless, albumin has not been clearly investigated in the outpatient setting where patients are generally considered healthier.[22–24] Patients undergoing elective outpatient procedures may also benefit from improving their nutritional status before surgery. Several small nonrandomized studies have reported that other underlying factors, such as underlying disease or ensuing inflammation, may contribute to the changes in preoperative albumin levels affecting any beneficial effects of nutritional therapy.[25–27]

Another important finding of the current investigation was the association of low-albumin levels and readmissions. Programs to optimize albumin levels of patients before elective surgery can be costly and this may impair the implementation of these programs. Nonetheless, cost savings from a reduction in readmissions, including penalty reduction from Medicare incentive programs, can be used to justify the implementation of preoperative albumin optimization programs.[28]

It was also interesting to note the significant association between low albumin levels and the development of a composite outcome of any infection (e.g., superficial wound infection, deep incisional wound infection, organ space wound infection, surgical wound disruption, pneumonia, urinary tract infection, sepsis, and septic shock). Albumin is established as a surrogate and culprit of infections as albumin oxidation and breakdown affect interactions with bioactive lipid mediators that play important roles in antimicrobial defence and repair.[29] Nevertheless, it was remarkable that the association between hypoalbuminemia and infections was detected in outpatient surgeries with otherwise low infection risk.

Other studies have investigated the role of albumin levels and the development of postoperative complications. Kishawi *et al.* concluded that there was a significant difference in 30-day postoperative complications between patients with normal preoperative albumin levels and those with low albumin levels after all primary total joint arthroplasties or revisions.[30] Similarly, Bhalla *et al.*

Table 3 Multivariate logistic regression model excluding malignancy, liver disease, and INR > 1.4 of patients with albumin levels < 3.5 g·dL^{-1} and albumin levels ≥ 3.5 g·dL^{-1}

Outcome	Odds ratio (95% CI)	P value	C statistic
Death	1.83 (0.86 to 3.89)	0.11	0.89
Any infection	1.52 (1.24 to 1.87)	< 0.001	0.66
Readmission	1.75 (1.47 to 2.08)	< 0.001	0.66
Any major complication	1.73 (1.24 to 2.41)	0.001	0.70

For each outcome, a multivariate logistic regression model was fit, adjusting for age, sex, body mass index, race (White as reference), American Society of Anesthesiologists Physical Status classification (III as reference), estimated probability of morbidity, and estimated probability of mortality. A total of 63,818 patients were included in each model, (60,408 with albumin levels ≥ 3.5 g·dL^{-1} and 3,410 with albumin levels < 3.5 g·dL^{-1})

CI = confidence interval; INR = international normalized ratio detected that preoperative serum albumin was independently associated with hospital LOS after radical cystectomy.[31] To the best of our knowledge, this is the first study to show an association between hypoalbuminemia and postoperative outcomes across multiple lower risk outpatient surgeries.

Our study can only be interpreted within the context of its limitations. First, we have chosen to take from the NSQUIP database all patients with a LOS less than one day and this limits the ability to determine what was a planned ambulatory surgery but became an inpatient procedure because of complications. Second, although we implemented a robust statistical analysis to control for potential confounding factors (e.g., no good measure of preoperative hepatic function), only a randomized trial can truly account for the role of unknown confounding biases that may have contributed to our results. Lastly, albumin may be a marker of frailty and this may limit beneficial effects of improving nutrition status preoperatively.

In conclusion, we have shown in a retrospective cohort of outpatient surgical cases that low albumin levels are associated with postoperative 30-day morbidity and mortality. This is important as more patients and complex procedures are being transferred to the ambulatory setting. Future randomized trials to evaluate the impact of hypoalbuminemia as a potentially modifiable preoperative marker before outpatient surgery are warranted.

Authors contributions *Sean Curran*, *Patricia Apruzzese*, *Mark C. Kendall*, *Gildasio De Oliveira* contributed to the design and conduct of the study, data analysis, data evaluation and interpretation, drafting the manuscript, and critical review of the manuscript. *Sean Curran*, *Patricia Apruzzese*, and *Mark C. Kendall* contributed to data acquisition.

Disclosures None.

Funding statement This work was supported by the Department of Anesthesiology, Rhode Island Hospital, Providence, RI, USA.

Editorial responsibility This submission was handled by Dr. Philip M. Jones, Deputy Editor-in-Chief, *Canadian Journal of Anesthesia/ Journal canadien d'anesthésie.*

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