Challenging the Surgical Axiom: Albumin Level Does Not Reliably Predict Development of Wound Complications in Patients Undergoing Body Contouring

Efstathios Karamanos, MD[1]; Pridvi Kandagatla, MD[2]; Howard Wang, MD[1]; Arielle Hodari Gupta, MD[2]; Aamir Siddiqui, MD[2]

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ABSTRACT

Introduction: Hypoalbuminemia has traditionally been associated with a poor nutritional status and subsequent high incidence of postoperative wound complications in surgical patients. Recent evidence, however, suggests that traditional nutritional markers are inadequate in predicting postoperative morbidity.

Objective: To test the hypothesis that preoperative albumin levels are not associated with adverse outcomes in patients undergoing body contouring.

Methods: All patients undergoing body contouring from 2015 to 2017 were identified using the American College of Surgeons National Surgical Quality Improvement Program database. Demographics, comorbidities, and wound classification were extracted from the database. The independent predictors of developing wound complications were identified. Logistic regressions were used to identify the impact of albumin on outcomes.

Results: During the study period, 4496 patients were identified. Wound complications developed in 202 patients (4.5%). Increasing body mass index, history of diabetes mellitus, American Society of Anesthesiologists classification, history of prior open wound, and tobacco use were independently associated with the development of postoperative complications. Albumin levels were not associated with the development of wound complications. Similarly, albumin levels were not associated with the need for a repeated operation, with readmission, or with the total hospital length of stay.

Conclusion: Albumin values were not associated with wound complications or need for reoperation in patients undergoing body contouring. Further research is warranted.

INTRODUCTION

Body contouring has become increasingly common since 2010, especially with the development of bariatric surgery leading to massive weight loss. Body-contouring procedures are often extensive, performed in an elective setting, and challenge the body in wound healing, which is critical for procedures.[1] Factors such as autoimmune disease, tobacco use, and nutritional status play a major role in wound healing and, therefore, play an important role in the postoperative course of patients undergoing body contouring. For this reason, many authors suggest a preoperative evaluation of patients' nutritional status.[2]

Albumin has been traditionally used as a marker of nutritional status by both nutritional specialists and surgeons to guide decision making regarding the optimal time for surgery. The traditional dogma dictates that preoperative hypoalbuminemia correlates with poor wound healing and higher incidence of wound complications after major surgery. However, this dogma has been challenged by several studies whose results show that the correlation between albumin levels and nutritional status is not as strong as once believed.[3] In fact, serum albumin levels may be affected only in individuals who are experiencing "extreme" starvation (defined as a body mass index [BMI] < 12 kg/m^2 or more than 6 weeks' starvation).[4] We hypothesized that preoperative albumin levels would not be associated with a higher incidence of wound complications in patients undergoing elective body contouring.

METHODS

Patients

All patients undergoing body contouring from 2015 to 2017 were identified using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database.[5] Table 1 lists the Current Procedural Terminology codes used for this study. Only patients with a preoperative albumin level within 30 days of the operation were included. Patients who did not have a clean wound classification at the end of the surgery were also excluded from further analysis to ensure the homogeneity of the study population.

The study population was then divided into 2 major groups depending on the development of wound complications. Wound complications were defined as wound dehiscence or superficial and deep surgical site infection. The definition of a surgical site infection was derived from the Centers for Disease Control and Prevention.[6]

The following variables were extracted from the database: Age, sex, race, tobacco use, BMI, and various comorbidities including diabetes, chronic obstructive pulmonary disease, hypertension, and recent body weight loss (defined as loss of > 10% of weight within the previous 30 days).

Outcome Measures

The primary outcome was the development of wound complications. These complications included wound dehiscence and

Author Affiliations

[1] Division of Plastic and Reconstructive Surgery, Department of Surgery, University of Texas Health Science Center, San Antonio

[2] Department of Surgery, Henry Ford Hospital/Wayne State University, Detroit, MI

Corresponding Author

Efstathios Karamanos, MD (ef.karamanos@gmail.com)

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superficial and deep surgical site infection. Secondary outcomes included need for reoperation within 30 days, need for readmission within 30 days, and total hospital length of stay.

Statistical Analysis

The 2 groups based on the development of wound complications were compared for their baseline characteristics. The Fisher exact test or χ^2 test was used to compare categorical variables as appropriate. Continuous variables were examined for normality of distribution using the Shapiro-Wilk test. Normally distributed variables were compared between the 2 groups using the Student *t*-test, and nonnormally distributed variables were compared using the Mann-Whitney (U) test.

To identify the independent predictors of development of wound complications, we used a forward stepwise logistic regression. The dependent variable was the development of complications, and the independent variables included all those that differed at a $p < 0.2$ in the previously performed univariate analysis. Independent predictors with adjusted odds ratios (AORs) and 95% confidence intervals (CIs) and adjusted p values were derived from the regression.

Next, the mean preoperative albumin level was calculated for each group on the basis of their outcome (yes vs no). The mean values were compared with their counterparts using the Mann-Whitney test or Student *t*-test as appropriate. The p values were reported.

To evaluate the impact of albumin on the development of wound complications, we used a binary logistic regression. The dependent variables inserted in the model were those that differed from the bivariate analysis at a $p < 0.2$. The preoperative albumin was inserted as a continuous variable. AORs with 95% CIs along with adjusted p values were derived from the regression. A similar process was replicated for the rest of the outcomes.

Table 1. Current Procedural Terminology (CPT) codes used

CPT code	Description
15830	Panniculectomy
15847	Abdominoplasty
15832	Excision, excessive skin; thigh
15833	Excision, excessive skin; leg
15834	Excision, excessive skin; hip
15835	Excision, excessive skin; buttock
15836	Excision, excessive skin; arm
15837	Excision, excessive skin; forearm
15838	Excision, excessive skin; submental fat pad
15839	Excision, excessive skin; other area
19300	Mastectomy for gynecomastia
19316	Mastopexy
19318	Reduction mammaplasty

Table 2. Demographics and clinical characteristics[a]

Characteristics	Overall (N = 4496)	No wound complications (n = 4294)	Wound complications (n = 202)	p value
Male sex	299 (6.7)	285 (6.6)	14 (6.9)	0.87
Age, y, mean (SD)	53 ± 8	53 ± 9	51 ± 11	0.91
Hispanic race	448 (10.0)	435 (10.1)	13 (6.4)	0.15
Alcohol use	2 (1.0)	1 (0.02)	1 (0.5)	0.32
Tobacco use	365 (8.1)	337 (7.8)	28 (13.9)	0.02
Albumin level, g/dL, mean (SD)	4.1 (0.3)	4.1 (0.4)	4.0 (0.5)	0.70
Total OR time, min, mean (SD)	175 (87.0)	172 (85.0)	181 (91.0)	0.71
BMI, kg/m^2, mean (SD)	27.8 (3.6)	26.9 (2.1)	33.7 (4.9)	0.02
Comorbidities				
Body weight loss > 10%	12 (0.3)	11 (0.3)	1 (0.5)	0.52
Chronic disease requiring use of corticosteroids	135 (3.0)	125 (2.9)	10 (5.0)	0.10
COPD	60 (1.3)	54 (1.3)	6 (3.0)	0.05
Diabetes mellitus	493 (10.9)	463 (10.8)	30 (14.8)	0.01
Hypertension	1432 (31.9)	1349 (31.4)	83 (41.1)	0.04
Open wound	45 (1.0)	35 (0.3)	10 (5.0)	< 0.01
Renal disease requiring dialysis	16 (0.4)	13 (0.3)	3 (1.5)	0.03
ASA classification[b]				
1	563 (12.5)	554 (12.9)	9 (4.5)	< 0.01
2	2721 (60.5)	2622 (61.1)	99 (49.0)	
3	1171 (26.0)	1086 (25.3)	85 (42.1)	
4	38 (0.8)	29 (0.7)	9 (4.5)	

[a] Data are presented as number (%) unless indicated otherwise. Some percentages do not total to 100 because of rounding.
[b] ASA classification was missing for 3 patients in the no-wound complications group.
ASA = American Society of Anesthesiologists; BMI = body mass index; COPD = chronic obstructive pulmonary disease; OR = operating room; SD = standard deviation.

RESULTS

During the study period, 4496 patients were identified and met the criteria to be included in the study. Of those, 202 patients (4.5%) experienced a wound complication, whereas 4294 patients (95.5%) did not. Most patients were female (93.3%, Table 2). The most common comorbidity was hypertension (31.9%), followed by diabetes mellitus (10.9%) and chronic disease requiring use of corticosteroids (3.0%, Table 2).

A stepwise forward logistic regression was performed to identify the independent predictors of developing wound complications in the study population (Table 3). The most important predictor was BMI (AOR = 1.54 [95% CI = 1.23-9.51], adjusted p < 0.01). Other independent predictors of wound complication development were a history of diabetes mellitus (Table 3). The C statistic for the model was 0.82 (95% CI = 0.71-0.86, p = 0.04).

There was no significant difference in the mean albumin levels regarding wound complications between the group with wound complications and the group without (Table 4). Preoperative albumin levels had no impact on wound complications after the 2 groups were adjusted for differences (Table 5). Similarly, preoperative albumin levels had no impact on the secondary outcomes when the differences were adjusted for (Table 5).

Table 3. Independent predictors of wound complications

Step	Variable	R^2	AOR (95% CI)	Adjusted p value
1	Body mass index	0.234	1.54 (1.23-9.51)	< 0.01
2	Diabetes mellitus	0.341	3.45 (1.12-9.55)	0.03
3	ASA classification	0.372	1.45 (1.23-5.61)	0.02
2	Open wound	0.401	1.27 (1.02-7.29)	0.04
3	Tobacco use	0.419	1.72 (1.04-11.31)	0.04

AOR = adjusted odds ratio; ASA = American Society of Anesthesiologists; CI = confidence interval.

Table 4. Outcomes

Outcome	Mean albumin (SD), g/dL	p value
Wound complications		
Yes (n = 202)	4.0 (0.5)	0.70
No (n = 4294)	4.1 (0.1)	
Reoperation within 30 d		
Yes (n = 121)	4.0 (0.7)	0.17
No (n = 4375)	4.1 (0.4)	
Readmission within 30 d		
Yes (n = 137)	3.9 (0.5)	0.57
No (n = 4375)	4.0 (0.4)	

SD = standard deviation.

Table 5. Impact of albumin level on outcomes

Outcome	AOR (95% CI)	Adjusted p value
Wound complications	1.05 (0.23, 4.31)	0.78
Reoperation within 30 d	0.99 (0.75, 2.83)	0.95
Readmission within 30 d	0.75 (0.41, 1.93)	0.34
Total length of stay	0.11 (-0.09, 0.32)	0.27

AOR = adjusted odds ratio; CI = confidence interval.

DISCUSSION

Our study found no association with albumin levels and several complications in patients undergoing body contouring. There was no significant difference in serum albumin levels in patients who had wound complications or a reoperation within 30 days and those who did not have either complication. The results were similar after performing a multivariate analysis as well. Although there was no difference in the development of wound complications, we did not account for the development of seromas. A low albumin rate, which could reflect a poor nutritional status, might result in a higher incidence of seromas in patients undergoing body contouring. When we analyzed all wound complications combined, there was no significant difference in serum albumin levels between those who had a complication and those who did not. Once again, these findings were similar after performing a multivariate analysis.

There are limited studies examining the influence of albumin levels on postoperative complications of body contouring. Fischer et al[7] analyzed the outcomes of 1797 patients through the same national database (ACS NSQIP) and found that there was a significant difference in albumin levels between patients with and without wound complications. This difference was also evident for major morbidity as well. The findings of our study are discordant with those of Fischer et al.[7] Our study did not find a significant difference among the serum albumin levels between patients with and without wound complications. Our study also examined the readmission and reoperation rates within 30 days, whereas these were not considered in the study by Fischer et al.[7]

There are, however, several studies looking at the complications after body contouring and various risk factors for the complications. Michaels et al[8] list some of the most common complications after body-contouring procedures. In their analysis of 700 patients, their overall complication rate was 42%. This rate was similar to that reported in a study by Momeni et al.[9] In a retrospective chart review spanning almost 10 years, the authors reported a minor complication rate of 28.8% and a major complication rate of 11.5%.[9] The overall complication rate was about 40%. This study examined risk factors for complications such as a history of smoking or previous surgeries. They did not look at preoperative nutritional status as a risk factor. Another study was more focused on the development of a seroma after body-contouring surgeries.[10] After body-contouring procedures, seromas developed in about 14% of the patients examined in the study. After a multivariate analysis, the risk factor found to be significant for the development of seromas was the weight of skin excised. Once again, the preoperative nutritional status was not examined.[10]

To our knowledge, our study is one of the few published studies to question the validity of using serum albumin levels as a predictor of complications after body contouring. The study is derived from a robust database comprising data from a multitude of hospitals (ACS NSQIP). This poses a strength compared with other studies derived from a single institution.

There are also limitations to this study. This is a retrospective study, which presents various biases for that reason. In addition, we are not able to determine the context of the body contouring performed for the patients. That is, we are not able to gather from the NSQIP database whether these procedures were performed after weight loss that was a result of bariatric surgery. This is important because of the high prevalence of nutritional deficiencies among patients with a history of bariatric surgery.[11] A subgroup analysis of patients with a history of bariatric surgery would have strengthened this study even more.

We challenge the dogma that preoperative albumin levels should be used as a predictor for postoperative wound complications after body contouring. This notion arose from the proposed link between albumin levels and nutritional status. Therefore, many saw patients with lower albumin levels as malnourished. This belief is being challenged throughout many disciplines as more studies are showing that lower albumin levels may be present for various reasons, not only for malnourishment.[12] These findings warrant further study of albumin levels as preoperative risk factors for postoperative wound complications.

CONCLUSION

We found conflicting evidence regarding the use of serum albumin values as a reliable predictor for development of wound complications in patients undergoing body contouring. As such, new, more reliable predictors must be identified in an effort to counsel these patients in the preoperative setting regarding the risk of wound complications. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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