Preoperative prealbumin level as a risk factor for surgical site infection following elective spine surgery

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Abstract

Background: Nutritional status is a critical factor in patient outcomes in a variety of medical contexts. In the surgical fields, there is substantial evidence suggesting that clinical outcomes including infection risk and surgical efficacy may be affected by preoperative nutritional status. The purpose of this study is to evaluate preoperative serum prealbumin levels, the currently preferred serum biomarker of nutritional deficiency, in relation to the risk of developing a surgical site infection.

Methods: A retrospective case–control series was conducted comparing prospectively collected preadmission serum prealbumin levels to the risk for surgical site infection following elective spine surgery. The analysis was conducted under an approved institutional quality assurance protocol. Patients were identified by querying the department billing codes for deep wound washouts over a 3-year period. A cohort of 32 patients with preoperative prealbumin levels who underwent spine surgery complicated by postoperative deep tissue infection was identified. This was compared against a case–control cohort of 74 patients who underwent spine surgery and did not experience postoperative infection. Clinical variables included demographic information, body mass index, smoking, diabetes, steroid use, length of the procedure, and length of hospital stay. The data were analyzed using multivariate Cox regression.

Results: Two variables: Preoperative prealbumin < 20 and diabetes were both statistically significant predictors for the risk of developing a postoperative infection with hazard ratios of 2.12 (95% confidence interval [CI]: 1.03–4.37) and 2.22 (95% CI: 1.04–4.75), respectively.

Conclusions: Our results reinforce the relationship between preoperative nutritional status and outcomes in elective spine surgery. The data indicate that preoperative prealbumin levels may be useful in risk stratification. Further study is needed to determine whether nutritional supplementation may reduce the risk of infection.

Key Words: Malnutrition, nutrition, prealbumin, spinal fusion, spine surgery

INTRODUCTION

Nutritional status is a critical factor in patient outcomes in a variety of medical contexts.[4,7,10,14,15] Surgical outcomes have been linked to patients' preoperative nutritional status in multiple sub-specialties.[1,5-8,10,16,19] Currently, transthyretin, more commonly referred to as prealbumin, is the preferred serum biomarker for the assessment of nutritional status due to a shorter half-life than the historically utilized marker, albumin. [2,3,14] Up to 40% of patients over the age of 60 undergoing spinal decompression and fusion are malnourished based upon serum albumin levels;[12] prospective data regarding prealbumin as a nutrition marker in spine surgery are lacking. We recently reported a retrospective link between impaired postoperative nutritional markers (low prealbumin) to deep wound surgical site infection.[20] As a result of that work, we began routinely measuring prealbumin levels preoperatively in patients undergoing elective spine surgery in our institution. The current study evaluates preoperative serum prealbumin levels in relation to the risk of developing a surgical site infection following elective spine surgery.

METHODS

A retrospective case–control series was conducted comparing prospectively collected, preadmission, serum prealbumin levels to the risk for surgical site infection following elective spine surgery. The analysis was conducted under an approved institutional quality assurance protocol. In August of 2009, prealbumin was added to the routine preoperative laboratory panel for all patients undergoing elective spine surgery by the two senior authors at Presbyterian Hospital at the University of Pittsburgh Medical Center. A cohort of patients who experienced postoperative wound infections between 2009 and 2012 was identified. The resulting 292 surgical wound washouts performed during this 3-year period were further narrowed to patients with available preoperative prealbumin levels. Patients with a known cancer diagnosis, with traumatic or infectious pathology, or who underwent minimally invasive or anterior approaches to the spine were further excluded. The above process resulted in 32 patients meeting criteria for inclusion. Subsequently, a case–control cohort of 74 patients who did not experience a postoperative wound infection was assembled from a database of all patients who underwent elective open posterior spinal surgery during the same time interval. Patients were selected based on surgical location, age, number of levels operated, and the availability of preoperative prealbumin levels. The electronic medical record for each patient was then reviewed, and additional clinical and demographic data were collected. Statistical analysis was performed by the department statistician using

SPSS (IBM, Armonk, NY, USA). Table 1 summarizes the demographic characteristics for each cohort of patients.

RESULTS

Table 2 summarizes further clinical information for each cohort. Duration of follow-up for the control cohort was 315 ± 322 days ensuring that patients were followed long enough for an infection to manifest. In addition, as expected and indicating the significant cost associated with postoperative wound infections, the total days spent in the hospital was longer in the infected cohort.

A Chi-squared analysis was used to assess for differences in the basic clinical and demographic parameters found in Table 1 between the infected versus noninfected cohorts. No significant difference was found in the age, male/female ratio, body mass index, operative time, and co-morbidities. This indicates our two groups to be similar

Table 1: Summary of patient demographics and surgical characteristics by cohort

Variable	Infected cohort	Control cohort
Number of patients (n)	32	74
Age (years)	61 (15)	58 (14)
Male/female ratio	0.78	0.78
BMI (kg)	32 (9)	29 (6)
Preoperative prealbumin	23 (10)	25 (7)
n≤20 (%)	13 (40.6)	16 (21.6)
Operative time (min)	207 (105)	233 (86)
Surgery location n (%)		
Lumbar	19 (59)	51 (69)
Thoracic	1 (3)	1 (1)
Cervical	6 (19)	9 (12)
Thoracolumbar	4 (13)	6 (8)
Cervicothoracic	2 (6)	7 (9)
Levels fused n (%)		
2	7 (22)	20 (27)
3	7 (22)	14 (19)
4	6 (19)	14 (19)
≥5	11 (34)	26 (35)
Comorbidities n (%)		
Diabetes	10 (31)	11 (15)
Chronic steroids	2 (6)	4 (5)
Smoking	8 (25)	22 (30)

BMI: Body mass index

Table 2: Summary of clinical treatment

Variable	Infected cohort	Control cohort
Clinical follow-up (days)	N/A	315 (322)
Time to infection (days)	21 (11)	N/A
Number of washouts performed	4 (2)	N/A
Total hospital days	27 (10)	4 (3)

N/A: Not available

in composition. The number of patients with diabetes trended toward but did not reach clinical significance with a $P = 0.052$. The only difference between groups that was statistically significant was the number of patients considered nutritionally deficient ($P = 0.04$) preliminarily indicating nutrition status is linked to risk for postoperative infection. A univariate Cox regression model was further utilized to determine the effect of variables on the primary endpoint: Development of infection. Additionally, multivariate regression was subsequently performed on factors with $P < 0.1$ in the univariate analysis to confirm significance accounting for confounding factors. The results are summarized in Table 3. In the univariate analysis, two variables were significant predictors of infection development: Prealbumin levels ≤20 ($P = 0.041$, hazard ratios [HR] 2.12) and diabetes ($P = 0.041$, HR 2.22). Both of these variables remained significant upon multivariate analysis indicating that both are independent risk factors for the development of an infection.

DISCUSSION

The current study demonstrates a link between preoperative nutritional status (low serum prealbumin) and postoperative risk for development of a deep wound infection. We previously reported that decreased prealbumin levels were noted in patients with deep wound infection at the time of re-admission for infection.[20] Prealbumin, however, is known to be lowered in an acute phase response and, therefore, no conclusions could be drawn regarding whether preoperative prealbumin levels could predict the development of an infection.[9] The current analysis, however, demonstrates this link. Diabetes was also found to be an independent risk factor for the development of a postoperative infection; multivariate analysis confirmed that both low serum prealbumin and diabetes were independent risk factors.

Table 3: Results of Cox regression analysis

Covariate	HR	CI	*P*
Univariate			
Age	2.12	1.03-4.37	0.159
Gender	1.08	0.52-2.24	0.835
BMI ≥30	1.55	0.76-3.17	0.233
Preoperative prealbumin ≤20	2.12	1.03-4.37	0.041
Diabetes	2.22	1.04-4.75	0.041
Chronic steroids	1.00	0.24-4.22	0.995
Smoking	0.59	0.24-1.44	0.248
Area-lumbar	0.68	0.75-1.26	0.852
Levels fused	1.09	0.97-1.23	0.159
OR time (h)	0.98	0.75-1.26	0.852
Multivariate			
Preoperative prealbumin ≤20	2.15	1.05-4.44	0.037
Diabetes	2.26	1.05-4.84	0.037

CI: Confidence interval, HR: Hazard ratios, BMI: Body mass index, OR: Odds ratio

Several prior studies have linked nutritional status to postoperative complications in spine surgery utilizing albumin levels as a surrogate marker.[1,12,17,18] For instance, Schoenfeld *et al*. analyzed 5887 patients who underwent spinal arthrodesis.[17] In a subgroup analysis, patients with serum albumin values <3.5 g/dL were found to have significantly increased risk for mortality (odds ratio [OR] 13.8), complications (OR 3.6), wound infection (OR 2.4), and thromboembolic phenomenon (OR 4.0). Schoenfeld *et al*. in a prior analysis, also from the National Surgical Quality Improvement Program, of 3475 patients found albumin <3.0 g/dL to be a statistically significant predictor of mortality (OR 9.47), complication (OR 7.68), and major complication including deep wound infection (OR 9.1).[18] While albumin does appear to be a useful predictor of complications, serum prealbumin may be a more sensitive marker. Due to its shorter half-life, prealbumin may better detect early nutritional deficits. A direct comparison would ultimately be needed to compare the sensitivity of these markers.

The current study has several limitations. First, the study is a retrospective cohort analysis and is, therefore, subject to the limitations inherent to the study design. This is also a single institution analysis that was limited in selecting patients based on the availability of preoperative prealbumin levels. Thus, the patients in this study represent a small segment of those who have undergone spinal fusion at our institution. Further study is needed in this area to prove that nutritional status is a definitively useful tool for risk stratifying patients for postoperative complications. The ultimate goal would be to reduce postoperative infections through preoperative nutritional supplementation. While there have been several small trials of perioperative supplementation with total parenteral nutrition in deformity surgeries with largely negative results, there has been minimal work performed in this regard and represents a potentially inexpensive, noninvasive avenue by which complications may be reduced.[11,13]

CONCLUSION

Prealbumin is a useful marker of nutritional status that predicts patients who are at an increased risk of developing postoperative deep wound infections following spine surgery. This has changed our practice pattern to include further education regarding preoperative nutrition. Ultimately, further study is needed to determine whether the risk of developing an infection may be mitigated by preoperative nutritional supplementation.

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