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Preoperative Serum Albumin Level and Postoperative Septic Complications

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Abstract

Objective: **To determine whether preoperative serum albumin level is significantly related to postoperative infectious and wound healing complications, after having adjusted for other risk factors.**

Materials and Methods: **Medical records of patients undergoing major abdominal operations, who were without predisposing conditions for infection or existing infections, and were not given total parenteral nutrition (TPN) were reviewed. Data from 140 patients in the period 1997 to 1998 were analyzed to study the association between risk factors (preoperative serum albumin, age, sex, ASA class, operative time, and body weight), and postoperative septic complications (wound dehiscence, wound infection, pneumonia, anastomotic leakage, sepsis, and intra-abdominal collection).**

Results: **Only low serum albumin level (less than 3.0 gm/dl) and ASA class were significantly related to postoperative septic complications (odds ratio: 8.21; 95% CI: 3.21 - 21.00 and odds ratio: 2.56; 95% CI: 1.35 - 4.88, respectively).**

Conclusion: **The results of this study suggest that preoperative serum albumin level in patients without certain comorbid diseases is associated with postoperative infectious and surgical complications. Low serum albumin level can be used as a marker for nutritional deficiency, and TPN as nutritional supplement in certain subset of patients may reduce postoperative septic complications. Among other risk factors examined, only the ASA class was also signi-ficantly related to postoperative septic complications.**

Various studies in the past have noted that low preoperative serum albumin level is significantly related to postoperative septic morbidity and mortality, for many major surgical procedures.[1-10] In a recent review of the experience in esophageal anastomotic leakage conducted at our institution, low preoperative albumin level was found not to be significantly associated with leakage. However, most of these patients were given aggressive preoperative nutritional support, which may confound the association between (pretreatment) serum albumin level and anastomotic leakage. Stimulated by this finding, we reviewed the charts of our general surgical patients who underwent major abdominal operations, exclusive of esophageal surgery, at roughly the same time period. The objective of the study was to more clearly define the relationship between preoperative serum albumin level and postoperative septic complications at our institution.

Materials and Methods

We reviewed the medical records of patients admitted to the general surgical service at our institution, on whom major abdominal operations were performed during the one-year period between January 1997 and January 1998. The inclusion criteria were adult patients undergoing opened abdominal operations (Table 1). Patients with any form of preoperative infections patients with underlying diabetes mellitus, patients taking corticosteroids for any length of time, patients with advanced cancer (stage IV disease), and patients receiving preoperative

Table 1 Major abdominal operations performed

Operation	Number of patients (%)
Colonic resection, colostomy and anastomosis	49/140 (35)
Biliary tract operations (CBD exploration; hepatico-/choledocho-jejunostomy/duodenostomy; cholecystectomy)	42/140 (30)
Gastric resection and gastrojejunostomy	20/140 (14)
Exploratory laparotomy and adhesiolysis	9/140 (6)
Pancreatoduodenectomy7/140	(5)
Hepatectomy	5/140 (4)
Miscellaneous (porto-systemic shunt; abdominal tumour removal; adrenalectomy; pancreatic cystojejunostomy; distal pancreatectomy)	8/140 (6)

Table 2 Septic complications: definitions and frequencies

Complications	Number of patients (%)
Wound infection: gross purulence	14/140 (10)
Wound dehiscence: obvious wound disruption	3/140 (2.1)
Anastomotic leakage: operative or radiologic findings	4/140 (2.9)
Intra-abdominal collection: operative or radiologic findings	3/140 (2.1)
Pneumonia: positive clinical, radiologic, or sputum culture	8/140 (5.7)
Sepsis : clinical manifestations of sepsis with sources besides those mentioned above, and positive hemoculture	7/140 (5)
Overall number of patients with complications	32/140 (22.9)

total parenteral nutrition (TPN) were excheded. There were 140 patients for whom the records were sufficiently complete for analysis. The records were studied for preoperative serum albumin level obtained within one week before operation, and for other potential risk factors of operative morbidity: age, sex, American Society of Anesthesiologists (ASA) class, operative time, and body weight. The outcomes of postoperative infectious and wound healing complications (collectively defined as postoperative septic complications): pneumonia, wound infection and dehiscence, anastomotic leakage, sepsis, and intra-abdominal collection (Table 2). All the above potential risk factors were simultaneously analyzed for significant association with postoperative morbidity using multiple logistic regression in a backward stepwise manner.[11] Two-sided p-values of 0.05 or less were considered statistically significant. Results were reported as odds ratios and 95% confidence intervals (95% CI), along with 2-sided p-values. All statistical analyses were done using STATA v.7 statistical software.

Results

The risk factors for postoperative septic complications are presented in Table 3 for those with without complications. There were 32/140 (23%) patients with postoperative septic complications in this series. Low serum albumin level (categorized as less than 3.0 gm%, or otherwise) and ASA class were significantly related to postoperative septic complications on univariable analysis by chi-square test.

On backward stepwise multiple logistic regression essentially the same conclusion was reached. The odds ratios and 95% CI's for the final model are presented in Table 4. When preoperative serum albumin level was less than 3.0 gm% the patient would have an 8-fold odds (here equivalent to a 5-fold risk) of postoperative septic complications, relative to the patient with a level of 3.0 gm/dl or higher. ASA class was linearly related to postoperative infectious and wound healing complications in the logistic model, with a 2.5 fold increase in the odds of complications (or 2.2 fold increase in the risk) for each increase in the ASA category. Preoperative serum albumin level was a better predictor of postoperative septic complications than the ASA class as can be seen by the area under the Receiver Operating Characteristic (ROC) curve (also called c-index1) of 0.72 for serum albumin level vs. 0.65 for ASA class.

A secondary analysis was performed for the outcome "surgical septic complications" defined as wound infection, wound dehiscence, anastomotic leakage, or intraabdominal collection. There were 21/140 (15%) patients with surgical complications. Interestingly, the only risk factor significantly related to this group of complications, out of the 6 factors studied, was preoperative serum albumin level less than 3.0 gm%. ASA class was not significantly related to this outcome. The odds ratio (95% CI) for serum albumin level less than 3.0 gm/dl was 3.13 (1.17-8.31), or around 3-fold risk of surgical complications, somewhat lower than the 5-fold risk for all septic complications.

Table 3 Risk factors for postoperative septic complications

Risk factors	Patients without complications n = 108	Patients with complications n = 32
Serum albumin level < 30 gm/dl: yes (%)*	14 / 108 (13.0)	18 / 32 (56.3)
Sex: male (%)	56 / 108 (51.9)	18 / 32 (56.3)
Age: years (mean ± sd.)	54.8 ± 15.8	57.6 ± 16.4
Body weight: kg (mean ± sd.)	55.5 ± 12.3	53.8 ± 15.0
Operative time >3 hours: yes (%)	42 / 108 (38.9)	13 / 32 (40.6)
ASA class*:		
1: no. (%)	25 / 108 (23.2)	4 / 32 (12.5)
2: no. (%)	67 / 108 (62.0)	15 / 32 (46.9)
3: no. (%)	16 / 108 (14.8)	9 / 32 (28.1)
4: no. (%)	0	4 / 32 (12.5)

**Significantly different between groups at 5% level by chi-squared test*

Discussion

Preoperative serum albumin level has been well documented to have significant association with postoperative infectious and wound healing complications for a wide variety of surgical settings.[1-10] A recent large-scale prospective cohort study (the VA surgical risk study[1]) confirmed this relationship, but the association was strongest for infectious complications.[1,9] We undertook this retrospective study on a group of general surgical patients without known comorbidities predisposing postoperative infections to see whether the same association holds for our patients. The study was partly stimulated by the finding of our previous retrospective study that low preoperative serum albumin level was not related to esophageal anastomotic leakage, contrary to expectations.[7,8] It was thought best not to focus on any specific group of surgical patients, to broaden the generalization of our data. Our results revealed that the condition associated with low preoperative serum albumin level was a significant risk for postoperative infectious and wound complications, as would be expected. This risk was, as with the VA surgical risk study, higher when all infectious complications were included than when wound complications alone were considered. Also, it is perhaps not surprising that ASA class was significantly related to the same outcome since other major studies obtained similar results.[1,2]

Several reports found preoperative serum albumin level to be a poor predictor of postoperative complications.[12-14] There may be various to account for this lack of association. TPN administration prior to surgery effective altered the nutritional status of the patient. Thus, preoperative serum albumin levels determined prior to TPN administration, no longer reflected the true nutritional status of the patient. In this study only patients not given TPN were eligible for inclusion, thus avoiding the masking effects of TPN.

Table 4 Significant risk factors for postoperative septic complications

Risk factors	Odds Ratio (95% CI)	p-value
Serum albumin < 3.0 gm/dl	8.21 (3.21 - 21.00)	<0.01
ASA class*	2.56 (1.35 - 4.88)	<0.01

**OR is per "unit" increase in ASA class (e.g.. from class 2 to class 3)*

In one study of 221 patients undergoing cardiac surgery,[12] serum prealbumin, as well as other nutritional protein markers such as serum transferrin and retinol binding protein, were found not to be significantly related to sternotomy wound infection. Although serum prealbumin was used in the study, it has a similar, role as serum albumin in predicting postoperative wound complications.[15] They encountered only 6 sternal wound infections (2.7%) in the whole series. In two other studies, one conducted on a cohort of 302 general surgical patients[13] and the other on 170 patients undergoing primary hip or knee prosthesis surgery,[14] the lack of association between preoperative serum albumin level and postoperative wound and infectious complications could be explained by the fact that most of these patients were well nourished preoperatively. Both studies reported on average

preoperative serum albumin levels above 4 gm/dl, and in one study only 11 per cent of patients had levels below 3.5 gm/dl. In contrast, in the VA surgical risk factors study,[1] 23 per cent of their patients had preoperative albumin level below 3.5 gm/dl and in the current study 23 per cent of patients had levels below 3.0 gm/dl.

A common reason invoked to explain the association between serum albumin level and postoperative septic complications is that serum albumin is a marker for circulating visceral protein,[16,17] a direct measure of nutritional and immunological status. Serum albumin itself may not be one of the essential components in the wound healing process, since analbuminemic patients can have normal wound healing.[18] This may be true in most clinical situations, but in a recent study of 2,745 cardiac surgical patients admitted to a cardiovascular intensive care unit, postoperative complications were not associated with preoperative hypoalbuminemia (serum albumin less than 3.5 gm/dl) alone or in combination with other malnutrition markers (body mass index less than 20 kg/m^2), but rather were associated with hypoalbuminemia in combination with liver dysfunction or in combination with cardiac failure.[19] If true, then this finding, at least for cardiac surgical patients, may imply that other conditions besides malnutrition may underlie the association between hypoalbuminemia and postoperative complications.

Although our findings demonstrated that low preoperative serum albumin level was associated with increased postoperative infectious and wound complications, several critical points may be worth mentioning. Since this is a retrospective study, our selection of patients for whom the records were complete could introduce a selection bias, even there was no indication that the excluded patients were different from the ones studied. Our set of risk factors may have excluded important variables which could "explain" the relationship between serum albumin level and postoperative septic complications. We have attempted to avoid this problem by excluding patients with previously known comorbid conditions associated with septic complications. A more comprehensive list of surgical risk factors can be found in the VA surgical risk study.[1] Finally, our definitions of the risk factors and postoperative complications may not be sufficiently precise, leading to measurement bias.

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