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Original Article

Preoperative hypoalbuminemia and dialysis increase morbidity/mortality after spine surgery for primary pyogenic spinal infections (ACS-NSQIP Study)

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ABSTRACT

Background: We analyzed the role of hypoalbuminemia, dialysis, and other risk factors that increase morbidity/mortality following surgery for primary pyogenic spinal infections (PSIs). The American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) that included 627 patients was utilized as our database.

Methods: Primary spinal surgery for spondylodiscitis was evaluated in a ACS-NSQIP database involving 627 patients between 2010 and 2019. Outcome assessment included evaluation of 30-day postoperative morbidity, and mortality rates.

Results: Within 30 postoperative days, complications occurred in 14.6% (92/627) of patients; 59 (9.4%) required readmission, and 39 (6.2%) required additional surgery. The most common complications were: wound infections, pneumonia, septic shock, and death (1.8%). Hypoalbuminemia (i.e., significantly associated with unplanned readmission and reoperation), and dialysis were the two major risk factors contributing to increased perioperative morbidity and mortality.

Conclusion: Among 627 ACS-NSQIP patients undergoing primary surgery for PSIs, hypoalbuminemia and dialysis were associated with higher risks of major perioperative morbidity (i.e., within 30 postoperative days – mostly readmissions and reoperations) and mortality.

Keywords: Dialysis, Hypoalbuminemia, Readmission, Reoperation, Spondylodiscitis

INTRODUCTION

Pyogenic spinal infections (PSI) occur in between 0.5 and 2.4/100,000 patient/year.^[9] This incidence will likely increase given the rising prevalence of spine operations performed in an aging population with increased comorbidities including diabetes, renal failure, and intravenous drug use.^[6,7] Here, we explored the correlation between hypoalbuminemia and/or dialysis

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with the incidence of perioperative (i.e., defined as <30 postoperative days) morbidity and mortality in patients undergoing primary surgery for PSIs.

MATERIALS AND METHODS

Study design and criteria

Institutional Review Board exemption was obtained from our institution. We utilized the American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) database looking at 627 patients undergoing primary spine surgery for spondylodiscitis between 2010 and 2019. We looked at a variety of demographics including comorbidities (i.e., diabetes, hypertension, chronic obstructive pulmonary disease (COPD), congestive heart failure, smoking, chronic steroid use, and dialysis), and 30-day outcomes (i.e., postoperative morbidity and mortality rates using major vs. minor Glassman classification) based on Classification of Diseases 9th and 10th codes and Current Procedural Terminology (CPT) codes [Table 1].^[5]

Surgical data

Spine operations were defined as cervical if performed between C0 and C7-T1, thoracic if from T1 to T12-L1, and lumbar if from L1 to the sacrum. Primary outcomes were assessed at 30 postoperative days and included; the evaluation of; 1) major complication rates, 2) wound-complications, 3) mortality rates, 4) unplanned readmissions, 5) reoperations, 6) operative times, and 7) fusion rates.

Preoperative laboratory studies

Preoperative laboratory data included albumin levels, with hypoalbuminemia being defined as <3.5 g/dl.

Statistical analysis

Outcomes were analyzed utilizing univariate analysis based on the demographics, preoperative comorbidities, and other

Codes and procedural	Definition
ICD-9: 722.90, 722.91, 722.93, and 722.94	Discitis, spondylodiscitis, and epidural abscess
22551, 22552, and 22554	Anterior cervical, anterior thoracic, and anterior lumbar surgery
22590, 22595, and 22600	Posterior cervical, posterior thoracic, and posterior lumbar surgery

surgical variables. Comparisons were performed using Chi-square tests, Fisher's exact test, or Student's *t*-tests.

RESULTS

The most common comorbidities for 627 patients from the NSQIP database undergoing predominant lumbar followed by cervical spinal surgery included diabetes (27.6%) and COPD (6.5%: smokers 28.4%); [Table 2].

Minor and major postoperative complications

A total of 71 (11.3%) patients sustained 92 complications within 30 postoperative days; 28 (30.4%) were minor, and

Table 2: Baseline demographic features.

Characteristics	Value
Age (mean/SD)	59.6±13.6
Sex (F/M)	252/375
BMI (median/IQR)*	28.2 (IQR 24.2–33.7)
Cervical region involvement (n/%)	148/23.6
Thoracic region involvement (n/%)	157/12.1
Lumbar region involvement (n/%)	740/57.1
Multilevel involvement (n/%)	24/1.9
Diabetes (n/%)	174/27.6
COPD (n/%)	41/6.5
Tobacco use (n/%)	178/28.4
Congestive heart failure (n/%)	15/2.4
Renal failure (n/%)	9/1.4
Dialysis (n/%)	50/8
ASA III/IV (n/%)	470/75
Operative time (minutes)*	131 (IQR 81–216)

*Non-parametric values. COPD: Chronic obstructive pulmonary disease

Table 3: Multivariate analysis of risk factors for major complications.

Variable	OR	95% CI	P-value
Age	0.99	0.96–1.02	0.23
Operative time (min)	1	0.99–1	0.88
Smoking	1.14	0.50–2.60	0.73
BMI	0.96	0.91–1.01	0.14
Diabetes	1.5	1.71–3.13	0.28
Dialysis	2	0.83–5.11	0.11
Hypoalbuminemia	3.95	1.55–10.05	0.004*
ASA III-IV	2.05	0.56–7.46	0.27
Fusion surgery	0.67	0.29–1.29	0.20
Multivariate analysis of risk factors for mortality			
Age	0.98	0.92–1.03	0.53
Sex	2.93	0.57–14.84	0.19
BMI	0.97	0.88–1.08	0.65
Smoking	0.63	0.11–3.45	0.59
Diabetes	0.95	0.22–4.05	0.95
Dialysis	12.01	3–48.03	0.0001*
Hypoalbuminemia	6.14	0.73–51.46	0.10
Operative time (min)	0.99	0.99–1.04	0.57

Table 4: Multivariate analysis of risk factors for unplanned readmission.

Variable	OR	95% CI	P
Age	1.01	0.99–1.04	0.14
Operative time (min)	1	0.99–1	0.95
BMI	0.98	0.94–1.03	0.60
Smoking	1.86	0.92–3.75	0.08
Diabetes	1.58	0.84–2.95	0.14
Dialysis	1.28	0.53–3.07	0.57
Hypoalbuminemia	2.26	1.12–4.55	0.02*
ASA III-IV	3.08	0.89–10.66	0.07
Fusion	0.60	0.32–1.12	0.11
Multivariate analysis of risk factors for Reoperation			
Sex	1.53	0.71–3.27	0.26
BMI	0.95	0.89–1	0.07
Smoking	2.35	1.11–4.94	0.02*
Diabetes	1.77	0.81–3.84	0.14
Dialysis	0.61	0.17–2.20	0.45
Hypoalbuminemia	2.37	1.02–5.51	0.04*
Operative time	1	0.99–1	0.73
ASA III/IV	3.54	0.79–15.8	0.09

*Significant value

64 (69.5%) were major. The most common complications in descending order were wound infections ($n = 23$ [3.7%] largely attributed to hypoalbuminemia), pneumonia ($n = 20$), septic shock ($n = 13$), cardiac arrest ($n = 11$), mortality ($n=11$ (1.7%): highly correlated with dialysis), deep vein thrombosis ($n = 10$), and urinary tract infection ($n = 5$) [Table 3].

Unplanned readmissions

Various factors were associated with readmissions observed in 59 patients (9.4%) within 30 postoperative days. These included hypoalbuminemia, dialysis, smoking, and an ASA of III-IV [Table 4]. Of interest, a median of 14 days (IQR 10–23.5) intervened between surgery and readmission.

Unplanned reoperations

There were 39 (6.2%) patients who required spinal reoperations within 30 postoperative days. Patients who were smokers or had hypoalbuminemia were the most likely to require secondary surgery [Table 4].

Table 5: Summary studies regarding hypoalbuminemia and dialysis as risk factors for complications and mortality.

Author (year)	Retrospective versus Prospective Study design/ Number of patients	Risk Factors' Hypoalbuminemia or Dialysis	Other Complications	Outcomes
Adogwa et al. (2014) ^[1]	R 136	Hypoalbuminemia		Increased Complications
Bohl et al. (2016) ^[2]	R4310	Hypoalbuminemia	Wound Dehiscence UTI	Unplanned Readmission
He et al. (2020) ^[6]	R 554	Hypoalbuminemia	Wound Dehiscence Higher Hospital costs	Increased LOS
Phan et al. (2019) ^[11]	R 2410	Hypoalbuminemia	Perioperative Complications Readmission	Increased LOS
Schoenfeld et al. (2013) ^[12]	R 5887	Hypoalbuminemia	Wound Infection Thromboembolic Complications	Higher Mortality
Cervan et al. (2012) ^[3]	P 23	Dialysis	New LBP	Spondylodiskitis
Chikuda et al.(2012) ^[4]	R 51648	Dialysis	Greater Risk of Cardiac Arrest Sepsis Respiratory Failure	Mortality
Hori et al. (2018) ^[7]	R 86	Dialysis	Lumbar Spine Surgery	Poorer Outcomes Higher Mortality
Madhavan et al. (2019) ^[8]	R 34	Dialysis	Spondylodiskitis	More Neurological Compromise
Ottesen et al. (2018) ^[10]	R 173778	Dialysis	Elective Spine Surgery Higher Risk	Higher Risk Reoperation Readmissions Death

R: Retrospective, P: Prospective, LOS: Length of stay, LBP: Low back pain

DISCUSSION

In this study, we analyzed morbidity and mortality rates for 627 patients from the ACS-NSQIP database undergoing surgery for PSI.^[8,9] Hypoalbuminemia was significantly associated with a higher risk of total, major, and wound-related complications, whereas dialysis was associated with a higher mortality risk. Prior studies have demonstrated albumin's role in the healing process and how hypoalbuminemia highly correlates with greater risks for wound-related complications [Table 5].^[1,2,6,11,12] Specifically, Schoenfeld *et al.* analyzed 5887 patients who underwent spinal fusion surgery through a NSIQP database and found that patients' age, ASA more than 2, high BMI, and poor nutritional status increased the risk of complications and mortality. Other studies also showed a positive correlation between patients on dialysis and higher mortality rates with spine surgery.^[3,4,7,8,10]

Postoperative complication leading to higher reoperation rates

Postoperative complications and adverse events in spine surgery are associated with higher morbidity, reoperation rates, and greater health-care costs.^[5] We found that smoking was significantly associated with higher reoperation rates, a finding consistent with the previous literature.^[1,2] There was also a significant association between hypoalbuminemia and both reoperations and unplanned readmissions; again, a finding consistent with prior studies.^[1,6] Phan *et al.*,^[11] in an ACS-NSIQP study of 2410 patients undergoing elective posterior lumbar fusion, found significantly higher unplanned readmission rates, hospital length of stay, and perioperative complications for patients with hypoalbuminemia.

CONCLUSION

Hypoalbuminemia was associated with a higher risk of major and wound-related complications whereas dialysis was associated with a higher mortality rate for patients undergoing primary spine surgery for spondylodiscitis.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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