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Socioeconomic Disparities in Outcomes Following Conservative Treatment of Spinal Epidural Abscesses

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ABSTRACT

Background: Primary spinal epidural abscess (SEA) is a rare but serious pathology that may result in severe neurologic injury. While certain literature has identified medical risk factors for failure of conservative therapy, no current evidence has been published regarding socioeconomic risk factors associated with failure of medical therapy.

Methods: A retrospective review was conducted of patients presenting with SEA from primary spinal infections. Patients presenting with magnetic resonance imaging evidence of SEA treated conservatively in the absence of neurologic deficits were included. Baseline clinical and socioeconomic characteristics were collected. Failure of medical management was defined as requiring surgical intervention despite maximal medical therapy due to the development of neurologic deficits or clinically significant deformity.

Results: A total of 150 patients were identified as presenting with magnetic resonance imaging evidence of SEAs without evidence of neurologic deficit. Of these patients, 42 required surgical intervention compared with 108 whose infection was successfully treated with medical therapy alone. Estimated average annual income was $64,746 vs $62,615 in those who successfully cleared their infection with medical management without requiring surgery, which was not statistically significant ($P = 0.5$). Insured patients were 5 times more likely to be successfully treated with antibiotics alone compared with uninsured patients (OR = 5.83, $P = 0.008$). Payer type, employment status, and incarceration status were not associated with failure of conservative therapy.

Conclusions: In the treatment of primary SEA, absence of medical insurance is associated with failure of medical management. Payer status, employment status, average salary, and incarceration are not significant risk factors for failure of conservative management.

Level of Evidence: 3.

Other and Special Categories

Keywords: osteomyelitis, discitis, epidural abscess

INTRODUCTION

Primary spinal epidural abscess (SEA) is a rare but concerning pathology with mortality rates reaching up to 80% prior to the widespread use of antibiotic therapy.[1] While these infections can be severe, a significant amount of heterogeneity exists regarding the ideal treatment of these lesions when no neurologic compromise exists.[2–4] In cases of no neurologic compromise, medical management is typically employed; however, rates of failure and need for surgical intervention have been cited as high as 50%.[5]

Recently, much evidence has emerged regarding disparities in access to health care and socioeconomic effects on clinical outcomes in medical subspecialties. Specifically, these factors have been shown to have a significant impact in a variety of surgical and nonsurgical pathologies.[6–8] In the setting of SEA, where the use of long-term intravenous antibiotics is necessary, socioeconomic factors may result in reduced access to care and consequently variable clinical outcomes.[9] In the present article, we provide the first study to date that evaluates socioeconomic factors in patients with SEA and their impact on outcomes.

METHODS

Following institutional board review approval, a retrospective review was conducted of all patients presenting with primary SEAs for primary spinal infections from 2000 to 2020. Patients were identified utilizing the International Classification of Diseases (ICD) 9th and 10th revision codes for SEA: ICD-9 324.9 and 324.1 and ICD-10 G06.2. Patients presenting with magnetic resonance imaging evidence of SEA confirmed by the attending radiologist and without neurologic deficits or significant associated deformity were treated with medical intervention with antibiotic therapy at the

discretion of the infectious disease team. Exclusion criteria were defined as patients younger than 18 years, those presenting with neurologic deficits on admission, patients undergoing surgical management as their initial treatment strategy, and patients in whom information was not available.

Failure of medical management was defined as requiring surgical intervention for more than 72 hours after the initiation of antibiotics due to neurologic decline, progressive infection despite completion of antibiotic regimen, or clinically significant progressive deformity despite maximal medical therapies. Variables examined were selected by the authors given their association with the failure of medical management in other known studies evaluating SEAs.[10] Immunocompromised state was defined as undergoing an immunosuppressive medication regimen for any reason, including transplant, autoimmune condition, or malignancy.

Descriptive statistics were reported with 95% confidence intervals. Odds ratios and Fisher exact test results are reported with an α set to 0.05. In keeping with prior literature, income was estimated using the zip code of each patient's residence and cross-referenced with the community survey's 5-year estimates available through the US Census Bureau.[6] Additionally, patients' race, ethnicity, insurance, and primary care provider status were identified in clinical records.

RESULTS

In total, 627 patients were identified as presenting with primary spinal infections from 2000 to 2020. Of these patients, 150 were identified as presenting with primary SEA.Of these patients, 135 identified as white, 7 identified as black, and 8 were unidentified; additionally, 22 patients identified as current smokers and 47 identified as former smokers. Insurance status was identified for 143 patients. Of these patients, 67 (44.7%) had private insurance, 60 (40.0%) had Medicare, 7 (4.7%) had Medicaid, and 9 (6.0%) were uninsured (Table 1). Among all patients, the mean income was found to be $64,146 (SD $18,393, range $29,583–$167,604). The lowest quartile was below $52,492, and the highest quartile was above $75,722.

Of the 150 patients, 42 failed conservative therapy and required surgical debridement. Of those requiring surgical intervention, patients were more likely to be women (64.3% vs 38.9%, P = 0.005, Table 2). Of those who failed medical therapy, surgical intervention occurred an average of 38.4 ± 44.1 days after initial evaluation. Clinical factors including body mass index, active malignancy, endocarditis, intravenous drug abuse, smoking status, alcohol use, dialysis, and blood cultures did not show a significant correlation with the failure of medical management. Average C-reactive protein at presentation was found to be significantly higher in the population who failed medical management (14.0 vs 21.3, P = 0.02).

Table 1. Demographic data of 150 patients presenting with spinal epidural abscess without neurologic deficit.

Variable	*n* (%)
Sex	
Men	81 (54.0)
Women	69 (46.0)
Race	
White	135 (90.0)
Black	7 (4.6)
Other	8 (5.3)
Smoking	
Current	22 (14.6)
Former	47 (31.3)
Alcohol	48 (32.0)
Dialysis	5 (3.3)
Positive blood cultures	97 (64.7)
Intravenous drug abusers	2 (1.3)
Active malignancy	9 (6.0)
Endocarditis	69 (46.0)
Insurance status	
Medicaid	7 (4.7)
Medicare	60 (40.0)
Private	67 (44.7)
Uninsured	9 (6.0)
PCP	
Has PCP	111 (74.0)
No PCP	9 (6.0)
Employment	
Employed	70 (46.7)
Unemployed	29 (19.3)
Retired	32 (21.3)
Incarcerated	11 (7.3)

Abbreviation: PCP, primary care provider.

Regarding socioeconomic factors, average salary was not found to be a significant factor in the prediction of failure of medical management ($64,746 vs $62,615, P = 0.5, Table 3). Presence of medical insurance was a significant predictor of failure of medical management, with 66.7% of uninsured patients failing medical management compared with 25.5% of patients with insurance (OR = 5.83, P = 0.008). Patients with a primary care provider were more likely to successfully complete medical management; however, this was not statistically significant (OR = 2.17, P = 0.27). Payer status, employment, and current incarceration were not found to be significant factors in the failure of medical management ($P > 0.05$). On subgroup analysis of risk of failure based on quartiles of estimated income, the first quartile was found to have the highest risk of requiring surgical intervention in 43.2% of cases compared with only 18.9% in the highest quartile group. However, this correlation did not reach statistical significance (Table 4, P = 0.08).

Table 2. Demographic data of patients completing conservative therapy vs those requiring surgical intervention.

Variable	Conservative (*N* = 108)	Surgery (*N* = 42)	*P* Value
Age (y)	60.8 ± 14.0	59.2 ± 10.6	0.45
Sex			
Men	66	15	
Women	42	27	**0.005**
Race			
White	98	37	
Black	6	1	
Other	4	4	0.50
Body mass index	32.4 ± 11.2	30.6 ± 7.2	0.25
Diabetes	78	29	0.14
MRSA	9	12	**0.001**
MSSA	70	18	**0.02**
Other organism	38	24	**0.02**
Above conus	49	26	0.07
Immunocompromised	2	0	0.37
Viral hepatitis	11	4	0.90
Active malignancy	4	5	0.058
Endocarditis	48	21	0.54
IVDA	2	0	0.37
Smoking			
Current	16	6	0.93
Former	32	15	0.47
Never	60	21	0.54
Alcohol use	37	11	0.34
Dialysis	4	1	0.69
Positive blood cultures	68	29	0.48
Average WBC, K/uL	12.9 ± 7.1	14.0 ± 6.8	0.38
Average CRP, mg/L	14.0 ± 10.2	21.3 ± 17.6	**0.02**

Abbreviations: CRP, C-reactive protein; IVDA, intravenous drug abusers; MRSA, methicillin-resistant Staphylococcus aureus; MSSA, methicillin-sensitive Staphylococcus aureus; WBC, white blood cell.
Note: Data presented as *n* or mean ± SD. Statistically significant findings are in boldface.

DISCUSSION

SEA represents a severe and potentially life-threatening infection with mortality rates reaching up to 16% and less than half of patients having a full recovery.[11,12] While SEA represents a rare pathologic lesion, some literature suggests an increase in frequency of these lesions, likely due to an increase in intravenous drug abuse, an aging population, the availability of magnetic resonance images, and long-term vascular access.[13,14] The primary treatment of SEA in the absence of neurologic compromise is antibiotic therapy; however, this therapy is frequently expensive and still associated with a 30% risk of requiring surgical intervention.[10]

Several past studies have evaluated failure of medical management in SEA; however, the identification of specific risk factors for failure has been infrequently reported. A study by Patel et al in 2014 reviewed 128 consecutive patients presenting with SEA. In this study, it was found that presence of positive blood cultures, diabetes, leukocytosis, and an elevated C-reactive protein (CRP) were strong predictive factors of failure of medical management. Additionally, 21 of 51 patients initially treated with medical therapy required delayed surgical intervention.[15] In a similar study by Kim et al in 2014, 127 patients were treated initially with medical management, of whom 54 (42.5%) ultimately required surgical intervention. In their subgroup analysis, they found that age >65 years, neurologic status, diabetes, and methicillin-resistant *Staphylococcus aureus* were significant risk factors for failing medical management.[16] Recently, other risk factors such as history of

Table 4. Subgroup analysis of need for surgical intervention compared with estimated income quartiles.

Quartile	Surgical	Conservative	Total	% Failure of Medical Management
Q1	16	21	37	43.20%
Q2	8	30	38	21.10%
Q3	11	27	38	28.90%
Q4	7	30	37	18.90%

Note: $P = 0.08$

Table 3. Comparison of socioeconomic factors on outcomes in spinal epidural abscess.

Socioeconomic Factor	Conservative (*N* = 108)	Surgery (*N* = 42)	*P* Value	OR	95% CI
Salary					
Mean	$64,746	$62,615			
SD	$19,073	$16,653	0.50		
Insurance, *n*					
Insured	105	36			
Uninsured	3	6	**0.008**	5.83	1.39–24.54
Payer status, *n*					
Medicaid	3	4			
Medicare	47	13			
Private	49	18	0.91		
PCP, *n*					
Has PCP	103	38			
No PCP	5	4	0.27	2.17	0.55–8.50
Employment, *n*					
Unemployed	18	11			
Employed	54	16	0.13	2.06	0.80–5.25
Prison status, *n*					
Not incarcerated	101	39			
Incarceration	7	3	0.88	1.11	0.27–4.51

Abbreviation: PCP, primary care provider.

compression deformity and current hepatitis B/C infection have also shown some recent evidence of being significant risk factors for failure of medical management, as described by Baum et al in 2021.[17] In our series, elevated CRP and female sex at the time of presentation were found to be associated with failure of medical management.

Socioeconomic disparities within the US health care system are a growing concern. Despite a growing body of evidence that socioeconomic barriers to health care exist, little research has been conducted showing how these barriers may be associated with poor outcomes. For example, a study by Attenello et al utilized the Kids' Inpatient Database for the evaluation of inpatient death and nonroutine discharges of patients undergoing cerebrospinal fluid shunt procedures. In their study, they found that African American patients and Medicaid patients had a higher likelihood of inpatient deaths and nonroutine discharges ($P < 0.05$).[7] Similar studies have been conducted across a variety of topics, including pituitary adenoma resections, spinal cord tumors, and degenerative spinal conditions, identifying the negative impact racial and economic factors have on health care–related outcomes.[6,18,19] In our study, a significantly higher risk of failing conservative therapy in the uninsured population was identified. While this is likely multifactorial, it can be speculated that the high cost of long-term antibiotic therapy may be partially responsible for a higher rate of failure in this population. Despite the development of home infusion programs to reduce the cost of treatments, these options frequently remain cost prohibitive in economically disadvantaged populations.[9] Additionally, the lowest quartile of average estimated income demonstrated the highest risk of necessitating surgical intervention. Altogether, these findings suggest that significant barriers to treatment still exist in providing access to the economically disadvantaged.

Though our study is the first to evaluate socioeconomic risk factors for failures of medical management of SEA, several limitations exist. When evaluating medical management for any condition, patient compliance represents a potentially significant factor and is difficult for us to comment on or quantify. While our sample size was relatively large, only a small number of patients were underrepresented minorities, making conclusions regarding racial disparities difficult. Additionally, while patients who were uninsured had a significantly higher rate of failure of medical management, this also represented a relatively small group of patients. Future studies should aim at recognizing racial inequities in care and identifying potential areas of improvement in our current health system. Additionally, while our method of estimating average income has been utilized in the literature previously, this only provides an estimate rather than reflecting the individual's actual income.

CONCLUSION

In the treatment of SEA, absence of medical insurance is associated with failure of conservative therapy. Payer type, employment status, estimated average salary, and incarceration are not significant risk factors.

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