The impact of Obstructive Sleep Apnea and its treatment on postoperative complications following posterior lumbar fusion

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INTRODUCTION: Obstructive Sleep Apnea (OSA) is the most common sleep-related breathing disorder and is associated with a multitude of cardiovascular complications if left untreated. Recent studies show OSA as an emerging risk factor for complications following surgical procedures. Posterior Lumber Fusion (PLF) is a workhorse procedure in spinal surgery allowing for posterior stabilization and three-column fusion if combined with an interbody cage. While treatment of OSA has been shown to decrease an individual's cardiovascular risk similar studies regarding OSA treatment have not been conducted regarding postoperative spinal complications. The aim of this study was to determine whether patients with OSA have an elevated risk of postoperative complications following PLF and if treatment of OSA prior to surgery impacts these complications.

METHODS: The Mariner database was utilized to identify patients age 18-84 undergoing PLF from 2010-2018, using Current Procedural Terminology (CPT) codes. Two main cohorts of patients were created, those with Obstructive Sleep Apnea (OSA) and control patients without OSA. Additional subgroups were created after stratifying for treatment of OSA with Continuous Positive Airway Pressure (CPAP). Post-operative outcomes assessed included major complications(pneumonia, pulmonary embolism, cerebral vascular accident, myocardial infarction, and sepsis) , minor complications(deep vein thrombosis, acute kidney injury, urinary tract infection, transfusion, and wound complications), dysphasia, emergency intubation, aspiration, dysphagia, infections, readmissions, and ED-visits within 90 days of surgery. Additionally, one- and two-year revision were assessed. Multivariate logistic regression was used to adjust for demographic and comorbid factors as well as number of levels operated on.

RESULTS: OSA alone did not appear to impact patient outcomes as there was was no significant difference in outcomes between the OSA and matched control group. Patients with untreated OSA were at an increased risk for postoperative complications following surgery including minor complications (12.4% vs 10.8%, OR 1.16, 95% CI 1.08-1.24, p < 0.001), major complications (5.3% vs 4.5%, OR 1.16, 95% CI 1.05-1.28, p = 0.003), pneumonia (2.0% vs 1.6%, OR 1.25, 95% CI 1.06-1.47, p = 0.006), wound complications (4.3% vs 3.2%, OR 1.36, 95% CI 1.21-1.53, p < 0.001), sepsis (1.2% vs 0.8%, OR 1.44, 95% CI 1.27-1.79, p < 0.001), surgical site infection (6.6% vs 5.3%, OR 1.25, 95% CI 1.14-1.37, p < 0.001), and ED-visits with 90 days (10.7% vs 9.5%, OR 1.14, 95% CI 1.09-1.23, p < 0.001). Revision rates were not significantly different across cohorts.

DISCUSSION AND CONCLUSION: Treatment of OSA in patients undergoing PLF is associated with a decreased risk of postoperative complications including pneumonia, Emergency Department visits, and infectious complications including wound complications, surgical site infections and sepsis. The origin of these findings could be linked to the catecholamine excess associated with untreated OSA which could provide a potent immunomodulatory effect resulting in these complications identified. We posit that routine preprocedural screening of all patients for OSA, in a manner akin to identifying a patient's diabetes, smoking and obesity status, may provide a yet unrecognized target in reducing post operative complications following PLF.

Table 1. OSA vs. Non-OSA Undergoing Posterior Lumbar fusion (Demographics)

		Untreated n = 22,669		Treated n = 22,669		p-value
Age Range	<34	287	1.3%	287	1.3%	1.00
	35-44	1289	5.7%	1289	5.7%	1.00
	45-54	3939	17.4%	3939	17.4%	1.00
	55-64	7216	31.8%	7216	31.8%	1.00
	65-74	7447	32.9%	7447	32.9%	1.00
	>75	2491	11.0%	2491	11.0%	1.00
Gender (Female)		11009	48.6%	11009	48.6%	1.00
Comorbidities						
Chronic Kidney Disease		1946	8.6%	1946	8.6%	1.00
Obesity		7013	30.9%	7013	30.9%	1.00
Chronic Obstructive Pulmonary Disease		3210	14.2%	3210	14.2%	1.00
Diabetes Mellitus		6186	27.3%	6186	27.3%	1.00
Coronary Artery Disease		4867	21.5%	4867	21.5%	1.00
Tobacco		4251	18.8%	4251	18.8%	1.00
Congestive Heart Failure		1715	7.6%	1715	7.6%	1.00
Hyperlipidemia		10625	46.9%	10625	46.9%	1.00
Peripheral Vascular Disease		2257	10.0%	2257	10.0%	1.00
Hypertension		11862	52.3%	11862	52.3%	1.00
Depression		5668	25.0%	5668	25.0%	1.00

Table 2. Untreated OSA vs. Treated OSA Undergoing Posterior Lumbar fusion (Demographics)

		Untreated n = 16,988		Treated n = 16,988		p-value
Age Range	<34	122	0.7%	122	0.7%	1.00
	35-44	824	4.9%	824	4.9%	1.00
	45-54	2898	17.1%	2898	17.1%	1.00
	55-64	5981	35.2%	5981	35.2%	1.00
	65-74	5558	32.7%	5558	32.7%	1.00
	>75	1605	9.4%	1605	9.4%	1.00
Gender (Female)		7490	44.1%	7490	44.1%	1.00
Comorbidities						
Chronic Kidney Disease		1049	6.2%	1049	6.2%	1.00
Obesity		5213	30.7%	5123	30.7%	1.00
Chronic Obstructive Pulmonary Disease		1772	10.4%	1772	10.4%	1.00
Diabetes Mellitus		4232	24.9%	4232	24.9%	1.00
Coronary Artery Disease		3036	17.9%	3036	17.9%	1.00
Tobacco		2491	14.7%	2491	14.7%	1.00
Congestive Heart Failure		846	5.0%	846	5.0%	1.00
Hyperlipidemia		7168	42.2%	7168	42.2%	1.00
Peripheral Vascular Disease		1272	7.5%	1272	7.5%	1.00
Hypertension		7947	46.8%	7947	46.8%	1.00
Depression		3501	20.6%	3501	20.6%	1.00

Table 3. OSA vs. Non-OSA Undergoing Posterior Lumbar fusion (Outcomes)

	Control n = 22,669		OSA n = 22,669		Adjusted OR (95% CI)	p-value
Major Complications	1289	5.7%	1231	5.4%	0.91 (0.77-1.05)	0.242
Minor Complications	2919	12.9%	2883	12.7%	0.92 (081-1.03)	0.113
Intubation	135	0.6%	136	0.6%	1.09 (0.75-1.63)	0.644
Aspiration	109	0.5%	106	0.5%	0.89 (0.60-1.36)	0.603
Dysphagia	557	2.5%	535	2.4%	0.97 (0.78-1.20)	0.542
PE	337	1.5%	333	1.5%	0.96 (0.76-1.21)	0.730
PNA	493	2.2%	457	2.0%	0.84 (0.69-1.03)	0.191
CVA	282	1.2%	251	1.1%	0.95 (073-1.23)	0.192
DVT	338	1.5%	319	1.4%	0.80 (0.64-1.01)	0.067
Transfusion	330	1.5%	343	1.5%	0.97 (0.78-1.23)	0.855
AKI	871	3.8%	865	3.8%	1.02 (0.87-1.19)	0.796
UTI	1025	4.5%	1021	4.5%	0.95 (0.83-1.10)	0.560
Wound Complications	947	4.2%	934	4.1%	0.98 (0.85-1.13)	0.801
Sepsis	271	1.2%	269	1.2%	0.94 (0.71-1.24)	0.660
Readmission	2250	9.9%	2387	10.5%	1.09 (1.00-1.20)	0.050
Surgical Site Infection	1473	6.5%	1394	6.1%	0.91 (0.82-1.01)	0.120
MI	152	0.7%	148	0.7%	0.87 (0.74-1.08)	0.463
Reoperation within 1 Year	845	3.7%	821	3.6%	1.01 (0.87-1.17)	0.863
Reoperation within 2 Years	1281	5.7%	1236	5.5%	0.99 (0.88-1.11)	0.886
ED-Visit	2722	12.0%	2628	11.6%	0.93 (0.85-1.01)	0.103

PE, Pulmonary embolism; PNA, pneumonia; CVA, Cerebrovascular accident; DVT, deep vein thrombosis; AKI, acute kidney injury; UTI, urinary tract infection; MI, myocardial infarction.
Bolded variables indicate statistical significance with P < 0.05

Table 4. Untreated OSA vs. Treated OSA Undergoing Posterior Lumbar fusion (Outcomes)

	Untreated n = 16,988		Treated n = 16,988		Adjusted OR (95% CI)	p-value
Major Complications	**771**	**4.5%**	**905**	**5.3%**	**1.16 (1.05-1.28)**	**0.003**
Minor Complications	**1833**	**10.8%**	**2112**	**12.4%**	**1.16 (1.08-1.24)**	**<0.001**
Intubation	79	0.5%	88	0.5%	1.09 (0.80-1.48)	0.568
Aspiration	69	0.4%	81	0.5%	1.15 (0.83-1.59)	0.393
Dysphagia	369	2.2%	367	2.2%	0.97 (0.83-1.12)	0.699
PE	253	1.5%	245	1.4%	0.95 (0.79-1.13)	0.583
PNA	**269**	**1.6%**	**340**	**2.0%**	**1.25 (1.06-1.47)**	**0.006**
CVA	144	0.8%	176	1.0%	1.20 (0.96-1.50)	0.104
DVT	221	1.3%	226	1.3%	1.00 (0.83-1.21)	0.969
Transfusion	209	1.2%	241	1.4%	1.13 (0.93-1.36)	0.198
AKI	569	3.3%	631	3.7%	1.09 (0.97-1.23)	0.116
UTI	631	3.7%	701	4.1%	1.10 (0.99-1.24)	0.070
Wound Complications	**542**	**3.2%**	**736**	**4.3%**	**1.36 (1.21-1.53)**	**<0.001**
Sepsis	**143**	**0.8%**	**208**	**1.2%**	**1.44 (1.27-1.79)**	**<0.001**
Readmission	1730	10.2%	1856	10.9%	1.06 (0.99-1.14)	0.079
Surgical Site Infection	**901**	**5.3%**	**1125**	**6.6%**	**1.25 (1.14-1.37)**	**<0.001**
MI	88	0.5%	109	0.6%	1.19 (0.89-1.58)	0.221
Reoperation within 1 Year	562	3.3%	597	3.5%	1.03 (0.92-1.16)	0.52
Reoperation within 2 Years	851	5.0%	880	5.2%	1.09 (0.91-1.11)	0.82
ED-Visit	**1613**	**9.5%**	**1820**	**10.7%**	**1.14 (1.06-1.23)**	**<0.001**

PE, Pulmonary embolism; PNA, pneumonia; CVA, Cerebrovascular accident; DVT, deep vein thrombosis; AKI, acute kidney injury; UTI, urinary tract infection; MI, myocardial infarction.
Bolded variables indicate statistical significance with P < 0.05