



Long-term Effects of Bone Morphogenetic Protein in Lumbar Fusion

Beatrice Ugiliweneza MSPH; Ranjith Babu MS; Chirag G. Patil MD MS; Shivanand P. Lad MD PhD; Abdul Baker MD; Maxwell Boakye MD

Department of Neurosurgery, University of Louisville School of Medicine; Department of Neurosurgery, Cedars-Sinai Medical Center; Division of Neurosurgery, Duke University School of Medicine



Introduction

Bone morphogenetic protein (BMP) was approved by the US Food and Drug Administration in 2002 for use in lumbar fusion surgery. Though it is thought to increase the likelihood of bone fusion and thus reduce reoperation rates, studies have yielded conflicting data. Additionally, recent studies have questioned the safety profile of BMP, noting trial design biases. The goal of this study was to 1) examine the two-year reoperation and complication rates; and 2) quantify the healthcare resource use for patients who underwent spinal lumbar fusion for degenerative conditions with and without BMP.

Methods

Reuter’s MarketScan database was utilized to identify 35,400 patients who underwent spinal fusion for degenerative lumbar disease between 2002 and 2009. Propensity score matching (PSM) techniques were used to match 4,310 patients who underwent spinal fusion with BMP to those who underwent spinal fusion without BMP.

Characteristics of the PSM cohort			
Variable	BMP use		p-value
	No (n=4310)	Yes (n=4310)	
Age, mean (SD)	52 (12)	52 (12)	0.6081
Gender: females, n (%)	2626 (60.93)	2655 (61.60)	0.5214
Charlson index, n (%)			0.9726
0	3478 (80.70)	3491 (81.00)	
1	671 (15.57)	657 (15.24)	
2	125 (2.90)	124 (2.88)	
3+	36 (0.84)	38 (0.88)	
Insurance, n (%)			0.6988
Commercial	3450 (80.08)	3421 (79.37)	
Medicaid	440 (10.21)	462 (10.72)	
Medicare	420 (9.74)	427 (9.91)	
Fusion type, n (%)			0.7648
Anterior	550 (12.76)	564 (13.09)	
Posterior	1352 (31.37)	1371 (31.81)	
Circumferential	2408 (55.87)	2375 (55.10)	

Comparison of post-operative outcomes			
Outcome variable	BMP use		p-value
	No (n=4310)	Yes (n=4310)	
1-year re-operation, n (%), aOR (95% CI)			
All-type	207 (4.80) REF	146 (3.39) 0.696(0.56,0.864)	0.0009*
Re-fusion	133 (3.09) REF	97 (2.25) 0.724(0.555,0.943)	0.0161*
New fusion	79 (1.83) REF	54 (1.25) 0.681(0.480,0.965)	0.0289*
1-year re-operation, n (%), aOR (95% CI)			
All-type	376 (8.72) REF	311 (7.22) 0.814(0.696,0.952)	0.0097*
Re-fusion	266 (6.17) REF	223 (5.17) 0.830(0.691,0.997)	0.0101*
New fusion	133 (3.09) REF	101 (2.34) 0.754(0.580,0.980)	0.0453*
Long-term re-operation			
Days to re-operation, mean (SE)	1999 (9)	2117 (14)	0.0028*
Overall re-operation, mean (SD)	530 (12.30)	446 (10.35)	0.0043*
Hazard, aHR (95% CI)	REF	0.825(0.727,0.935)	0.0027*
Complications, n (%)			
Index hospitalization	404 (9.37)	367 (8.52)	0.1626
30-day	454 (10.53)	412 (9.56)	0.1324
90-day	478 (11.09)	439 (10.19)	0.1731
Index hospitalization , mean (SD)			
Length of stay	4 (6)	4 (6)	0.1346
Costs	48590(35247)	55090 (35296)	<0.0001*
1-year inpatient use, mean (SD)			
Cumulative days	1 (6)	1 (5)	0.0807
Cumulative costs	5728 (19958)	5412 (20492)	0.1973
2-year inpatient use, mean (SD)			
Cumulative days	3 (9)	2 (8)	0.0109*
Cumulative costs	11414(29361)	11722 (39369)	0.0206*
1-year outpatient use, mean (SD)			
Cumulative services	73 (62)	72 (66)	0.5977
Cumulative costs	9303(11495)	8590 (10203)	0.0632
2-year outpatient use, mean (SD)			
Cumulative services	134 (112)	133 (123)	0.7510
Cumulative costs	17063(19655)	16067 (20549)	0.0125*
Combined inpatient and outpatient costs, mean (SD)			
1-year cumulative	15032(25349)	14002 (25154)	0.0443*
2-year cumulative	28476(40245)	27789 (50618)	0.0193*

Results

The use of BMP was associated with a reduced risk of reoperation at 1 (p=0.0010) and 2 years (OR:0.814, 95 %CI:0.696–0.952, p=0.0101) following the index procedure. Additionally BMP was not seen to be significantly associated with the occurrence of postoperative complications. Patients who received BMP had significantly higher index hospitalization charges (\$55,090 vs. \$48,590, p<0.0001) though the lengths of stay were comparable. This trend continued, with those in the BMP group having higher hospital charges over 2 years (p=0.0206), despite having fewer hospital days (p=0.0109). However the accumulated outpatient charges over 2 years were significantly lower in those who received BMP (p=0.01). This led the BMP group to have significantly lower inpatient and outpatient charges 2 years following the index procedure (\$27,789 vs. \$28,476, p=0.02).

Conclusions

Although BMP was associated with higher cost during the index hospitalization, two years following lumbar fusion, BMP was associated with lower reoperation rates, fewer hospital days, and less inpatient and outpatient charges.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe the importance of understanding the pros and cons of BMP use in lumbar fusion surgery, 2) Discuss, in small groups the efficacy of BMP in reducing reoperation risk with comparable complication rates and decreased long-term cost, 3) Identify an effective treatment for degenerative spine conditions which reduces the reoperation rates and long-term costs following spinal fusion.