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Research Article

Does Topical Vancomycin Powder Use in Instrumented Lumbar Spine Fusions Increase the Incidence of Vancomycin Resistant "Superbug" Infections?

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Abstract

In an effort to reduce the rate of Surgical Site Infections (SSIs), recent studies have reported using intrawound, topical vancomycin powder. Although cost-effective and promising results have been published, there is concern for development of antibiotic resistance and catastrophic "superbug" infections. The purpose of this study was to evaluate and compare the culture profile of Surgical Site Infection (SSI) in patients undergoing posterior lumbar instrumented fusions with topical vancomycin powder utilized versus controls prior to the use of topical vancomycin powder. Patients who had a posterior lumbar instrumented fusion and subsequently developed SSI requiring operative treatment from June 2007 to June 2008 and from June 2011 to June 2012 were identified. Standard demographic and surgical data were collected. Culture results and timing of the SSI relative to index surgery were also collected. Comparison of SSIs pre-vancomycin (2007-2008) and post-vancomycin (2011-2012) identified 31 versus 26 patients, respectively; no difference in demographic or surgical characteristics between time-dependent cohorts. There was no difference in the culture profile between groups (p=0.667). When comparing the culture profile of surgical site infections after posterior lumbar instrumented fusions, there appears to be no difference comparing a pre-Vancomycin interval versus a post-vancomycin interval. Additionally, comparing SSIs with or without topical vancomycin, regardless of time interval, showed no difference in culture profile. The results of this study suggest that topical vancomycin powder did not increase the incidence of vancomycin-resistant, "super bug" infections in the time period studied. Continued surveillance of this increasingly common practice is warranted.

INTRODUCTION

Following the 2011 publication by Sweet et al. [1], there has been an exponential increase in reports examining the application of topical vancomycin powder, as an increasingly common practice of prophylaxis against surgical site infection (SSI) in spine surgery. Although the majority of literature supports the theory that topical vancomycin powder reduces the incidence of surgical site infections, relevant clinical questions remain unanswered. These clinical questions include appropriate patient selection and dosing for efficacy, as well as questions about possible adverse events. With the widespread utilization of topical vancomycin, one of the theoretical adverse events of concern is the development of infections with vancomycin resistant bacteria, or "super bugs." To our knowledge, no studies have specifically compared the culture profile of SSIs after widespread adoption of vancomycin use. The purpose of the current study was to query a multi-center group of "early adopter" surgeons regarding the culture profiles of SSIs diagnosed at their institution in a time period before and after instituting the practice of applying topical vancomycin powder [2-13].

MATERIALS AND METHODS

After receiving Institutional Review Approval from all three study sites, patients > 18 years of age who had a posterior instrumented lumbar fusion and subsequently developed SSI from June 2007 to June 2008 and from June 2011 to June 2012 requiring operative irrigation and debridement were identified. These two time frames provided SSIs in which topical vancomycin

was not used and SSIs after which topical vancomycin became standard practice. Although no specific institutional "policy" existed, the site investigators verified that surgeon-directed topical vancomycin use became increasingly common during these time intervals. No other significant changes in peri-operative antibiotic use were reported. As part of standard of care, patients received a first generation Cepaholosporin one hour prior to incision. If the patient was allergic to Cepaholosporins or Penicillins, they were given Clindamycin with or without Gentamycin and/or Vancomycin. Antibiotics were administered for 24 hours after the end of surgery and then discontinued. Antibiotics were administered for 24 hours after the end of surgery and then discontinued. Comparison between these time intervals provides insight into the institutional infection profiles (institutional environment) before and after topical vancomycin became common practice. Antibiotic resistance can also develop secondary to selection within an individual patient in whom vancomycin powder was used (local environment). Therefore, we analyzed our data from both perspectives. Patients in which the indication for the index surgery was tumor, trauma, osteomyelitis or discitis were excluded. Patients in whom the index surgery was done outside their respective institution were also excluded. Demographic and surgical data were collected. Culture results and timing of the SSI relative to index surgery were also collected.

RESULTS AND DISCUSSION

Comparison of the SSIs in the pre-vancomycin time period (2007-2008) and post-vancomycin time period (2011-2012) identified 31 versus 26 patients, respectively (Table 1) with no difference in demographic or surgical characteristics. Gender distribution, age, smoking status, Charleston Comorbidity Index (CCMI), Body Mass Index (BMI), number of surgical levels, estimated blood loss (EBL), surgical time, surgical approach, primary versus revision, and distant foci were all similar between the two groups ($p > 0.05$). There was no difference in the culture profile between groups ($p=0.667$) (i.e. patients who received topical vancomycin and developed an infection had a similar distribution of offending infecting organisms as patients who did not receive topical vancomycin). In both groups, the majority of organisms cultured were staphylococcus aureus with the vancomycin group showing no increase in vancomycin-resistant or "super bug" organisms (Table 1).

When SSIs between patients who had topical vancomycin and no topical Vancomycin groups were compared, there were 16 versus 41 patients, respectively (Table 2) with no difference in demographic or surgical characteristics. Gender distribution, age, smoking status, Charleston Comorbidity Index (CCMI), Body Mass Index (BMI), number of surgical levels, estimated blood loss (EBL), surgical time, surgical approach, primary versus revision, and distant foci were all similar between the two groups ($p > 0.05$). There was no difference in the culture profile between groups ($p=0.739$) (i.e. patients who developed an infection in the later time period after local vancomycin was widely used had a similar distribution of infecting organisms as patients who developed an infection in the time period before local vancomycin was used). In both groups, the majority of organisms cultured were staphylococcus aureus with the post-vancomycin time period group showing no increase in vancomycin-resistant or "super bug" organisms (Table 2).

Table 1: Summary of Results comparing Pre-Vancomycin and Post-Vancomycin.

	Pre-Vancomycin (2007-2008)	Post-Vancomycin (2011-2012)	p-value
	31	26	
Male:Female	10:21	5:21	0.266
Age (years)	52.6	54.0	0.759
Smoker	13	11	0.977
Charlson Comorbidity Index	6.2	4.9	0.474
Body Mass Index (kg/m^2)	30.3	29.7	0.782
No of Levels	4.7	4.8	0.983
Estimated Blood Loss(mL)	692.5	751.9	0.801
Surgical Time(minutes)	267.2	281.3	0.645
Vancomycin powder	0	16	
Intravenous antibiotic			
Cefazolin	22	21	0.542
Gentamicin	2	1	
Vancomycin	8	6	
Clindamycin	3	0	
Surgical Approach			
Posterior Only	35	11	
Combined	6	5	0.182
Primary vs Revision			
Primary	18	17	0.598
Revision	13	9	
Distant Foci	1	2	0.056
Culture results			0.667
MRSA	8	5	
MSSA	5	7	
S. aureus	1	3	
S. epidermidis	1	1	
Coagulase Negative S. aureus	4	2	
Beta-hemolytic Strep	0	1	
E. cloacae	1	0	
E. coli	2	1	
E. faecalis	2	0	
Moraxella catarrhalis	1	0	
Prevotellabivia	0	1	
Proteus Mirabilis	2	1	
VRE	1	0	
Mixed	0	1	
Multiple organisms	3	2	
Negative	6	5	

Previous studies have reported using topical vancomycin to decrease in incidence of SSI following spine surgery. Although the majority of the literature suggest efficacy, possible adverse effects have not been thoroughly studied. [1-13]. One of the theoretical adverse events, is the development of antibiotic resistant infections. The current study suggests that the development of infections with antibiotic resistant organisms or "super bugs"

Table 2: Summary of Results comparing cases with Topical Vancomycin to those without.

	No Vancomycin Powder	Vancomycin Powder	p-value
	41	16	
Male: Female	12:29	3:13	0.418
Age (years)	52.7	54.4	0.752
Smoker	19	5	0.300
Charlson Comorbidity Index	5.8	5.0	0.637
Body Mass Index (kg/m^2)	29.8	30.7	0.662
No of Levels	4.8	4.7	0.949
Estimated Blood Loss(mL)	684.4	529.7	0.805
Surgical Time(minutes)	271.4	278.5	0.524
Intravenous antibiotic			
Cefazolin	30	13	
Gentamicin	3	0	
Vancomycin	10	4	
Clindamycin	3	0	
Surgical Approach			
Posterior Only	35	11	
Combined	6	5	0.153
Primary vs Revision			
Primary	24	11	0.477
Revision	17	5	
Distant Foci	1	2	0.133
Culture results			0.739
MRSA	10	3	
MSSA	6	6	
S. aureus	3	1	
S. epidermidis	2	0	
Coagulase Negative S. aureus	5	1	
Beta-hemolytic Strep	1	0	
E. cloacae	1	0	
E. coli	2	1	
E. faecalis	2	0	
Moraxella catarrhalis	1	0	
Prevotellabivia	0	1	
Proteus Mirabilis	2	1	
VRE	1	0	
Mixed	0	1	
Multiple organisms	4	1	
Negative	9	2	

after the utilization of intrawound topical vancomycin does not occur, at least under our study parameters.

Several limitations exist with the current study. Surgical site infections in the spine can be difficult to study secondary to the small sample sizes of a relatively rare event. We sought to utilize a multi-center approach to attempt to overcome this difficulty. Additionally, when analyzing the development of antibiotic resistance it can develop secondary to environmental selection or within an individual patient (local environment). We analyzed our data from both perspectives.

Another limitation is that the retrospective nature of the study makes it difficult to account for confounding variables such as which IV antibiotic is used for preoperative prophylaxis and if oral antibiotics were utilized when wound drainage was identified. Additionally, the technique or location of application is likely variable. A prospective study design would address these but would be lengthy to achieve a similar sample size, regardless; this should be the focus of future efforts. Also, time period selected is close to the initiation of the use of topical vancomycin. With longer periods of use, it is possible that widespread utilization will alter the institutional flora leading to antibiotic resistant infections in the future. Lastly, we do not identify the total number of instrumented lumbar fusions including in the study (total N). Therefore, we cannot calculate an infection rate. This has been extensively studied elsewhere and is not the purpose of the current study.

CONCLUSION

It has been reported that topical vancomycin leads to high local concentrations and relatively low systemic concentrations. This may help explain the lower risk of developing resistant organisms with topical vancomycin versus the use of intravenous vancomycin. Or our study time interval is too short and with recent widespread adoption, we have not studied this theoretical risk long enough. Nevertheless, continued surveillance of the seemingly increasingly common practice is warranted.

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CONFLICT OF INTEREST

CHC - is an employee of Norton Healthcare; received consulting fees from Alphatec, Medtronic and Nuvasive; received payments for speaking from Medtronic and Titan; received funds for trips and travel from SRS and NASS and is on the scientific board of Medtronic. JLG receives royalties from Acuity; receives consulting fees from Medtronic, DePuy, Alphatec, Stryker, Acuity, K2M, Nuvasuve, PacMed; receives honoraria from Pacira; and research support from Norton Healthcare, Integra, IntelliRod, Pfizer and the International Spine Study Group. LGL received royalties from Medtronic and Quality Medical Publishing, research support and consulting fees from DePuy; research support from Setting Scoliosis Straight Foundation; is a Board Member of Backtalk, Global Spine Outreach, OREF, JNS, Scoliosis, Spine Deformity, Spin, iscoliosis, Spine Universe; research support from EOS, Evans family Donation; Fox Family Foundation. JMB receives consulting fees from Advance Medical, CoreLink, Globus Medical, K2M, Medtronic and Stryker; research grants from CSSG/K2M and OREF; payments for speaking from Broadwater/Vertical Health,

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