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Original article

Do local antibiotics reduce periprosthetic joint infections? A retrospective review of 744 cases

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ABSTRACT

Periprosthetic joint infections (PJI) are uncommon but not rare and have significant morbidity and financial implications. Local antibiotics have been used successfully in other areas of orthopedics to reduce postoperative infections, but this method has not been proven in total joint arthroplasty (TJA). Beginning January 1, 2014, our primary investigators began using surgical site lavage with providone-iodine solution and administering 2 g of vancomcyin powder in the surgical wound prior to capsule closure for all primary and revision total hip and knee arthroplasties. We performed a retrospective chart review of patients two years prior to this date and two years after to compare occurrence of PJI. The groups were broken down into patients who received local antibiotics versus those who did not. The groups were further broken down by type of surgery performed; primary or revision total hip or knee arthroplasty. Administration of local antibiotics was preventative for PJI only in the primary total knee arthroplasty group (aOR = 0.28, 0.09–0.89). Administration of local antibiotics trended towards a preventative effect for PJI in the other groups but was not statistically significant. Patients receiving local antibiotics had similar blood urea nitrogen and creatinine levels postoperatively compared to the no antibiotics group indicating minimal systemic effects of local vancomycin powder. While the use of local antibiotics may prevent PJI, more data is required especially in the revision arthroplasty groups.

1. Introduction

Total joint arthroplasty (TJA) is a common procedure that will continue to grow in popularity due to the high rate of successful outcomes. By the year 2030 the demand for total hip arthroplasty (THA) is expected to grow 174% and the demand for total knee arthroplasty (TKA) is expected to grow 673%. Revision total hip (RTHA) and revision total knee arthroplasties (RTKA) are expected to grow 137% and 601% respectively by 2030.[1] Periprosthetic joint infections (PJI) are uncommon but not rare. The prevalence of PJI is 1.3% after THA, 3.2% after RTHA, 2% after TKA and 5.6% after RTKA.[2] Revision arthroplasty is a morbid and costly procedure that should be avoided if possible. One study showed a 30% increase in the cost of RTKA compared to TKA.[3]

The use of local antibiotics in TJA for infection prophylaxis is currently off label which is likely why there is scarce literature to advocate its use. Especially lacking are large multicenter prospective trials. There has been a trend towards increased usage of local antibiotics in surgical wounds in recent orthopedic literature, particularly orthopedic spine and trauma surgery. Most of these studies have been promising, showing reduced infection rates and costs savings in the local antibiotic group. One retrospective study using local vancomycin powder after posterior spinal fusion (PSF) showed not only a significant reduction in surgical site infections, but also a large savings in cost when comparing the need for a second surgery compared to the cost of vancomycin powder. In this study 0 out of 96 patients receiving local vancomycin powder required a second operation for surgical site infection versus 7 out of 207 in the control group. The cost of a single dose of vancomycin was determined to be $12, or $1152 for the entire study group. A total of $573,897 was spent on the 7 patients who had surgical site infections.[4] A retrospective study by O'Neill et al. of 110 patients undergoing PSF showed patients receiving standard systemic prophylaxis preoperatively had an infection rate of 13%, while the group that received standard prophylaxis plus local vancomycin

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had an infection rate of 0%.[5] A retrospective comparative study by Caroom et al. using prospectively collected data in patients undergoing posterior cervical fusion showed local use of vancomycin decreased infection rate from 15% to 0% in a group of 112 patients.[6]

Orthopedic trauma surgeons have advocated the use of local antibiotics in open fractures for decades. One trauma study observed 26 patients receiving vancomycin impregnated calcium sulfate after open reduction internal fixation of long bone fractures. Zero patients in this study had an infection at an average follow up on 10.5 months.[7] The use of antibiotic impregnated polymethyl methacrylate in grade II and III open fractures has been advocated by some. Ostermann et al. retrospectively reviewed 1085 patients with open fractures and found a reduction of infection in type III open fractures from 20% to 6.5% when aminoglycoside impregnated beads were added to systemic therapy alone.[8] However, antibiotic beads are not desirable for TJA because it would involve a second surgery to remove the beads and likely lead to third body wear.

Total joint surgeons have used anti-biotic impregnated cement in THA and TKA with some success. A systematic review and meta-analysis of 6381 patients undergoing TJA showed the relative risk of infection in patients receiving antibiotic impregnated cement versus plain cement was 0.47 ($p = 0.04$).[9] A more recent meta-analysis showed patients with antibiotic impregnated cement had a reduction in infection rate in THA but not TKA. This same study also showed adding antibiotics had a dose dependent reduction of compressive and tensile strength of the bone cement which was an unfavorable side effect.[10] Another trend in TJA is irrigating the surgical wound with diluted antibiotic solution prior to placement of permanent implants. A study of 1682 TJA compared infection rates between groups with and without providone-iodine lavage prior to permanent implant placement. This study showed a decrease in the 3 month deep infection rate (0.97%–0.15%, $p = 0.04$) in the providone-iodine group.[11]

The purpose of this study is to determine whether or not local antibiotics in primary and revision total hip and knee arthroplasties reduced the rate of PJI compared to systemic antibiotics alone. We also hope to show that the local use of vancomycin and providone-iodine is safe and does not create wound complications or systemic side effects. To our knowledge there are currently no studies on the usage of vancomycin powder and providone-iodine irrigation for the prevention of infection in TJA.

2. Patients and methods

After approval from the Institutional Review Board, a retrospective analysis was performed on patients from the Texas Tech University Department of Orthopedics during January 1, 2012 to December 31, 2015 undergoing TKA, RTKA, THA or RTHA. We chose this 4 year time period because our primary investigators began irrigating surgical wounds with providone-iodine (Betadine Microbicides) solution before placement of permanent implants and administering vancomycin powder in the wounds prior to closure of the joint capsule beginning January 1, 2014. This change in protocol was initiated due to recent literature from orthopedic spine and trauma studies showing reduced infection rates in patients treated with local administration of antibiotics at the surgical site. This time period allowed us to compare four years of data; two prior to the use of local antibiotics and two after.

During this time period we identified 897 procedures coded as TKA, THA, RTKA, or RTHA. Seven hundred and two patients were included in the study for a total of 744 procedures. Sixty-one patients that underwent revision hip or knee arthroplasty who had a pre-existing PJI were excluded from the study due to their high risk of re-infection. Ninety-two cases did not have a minimum of 6 months follow up and were excluded from the study. The indications for TKA or THA were patients with radiographic evidence of osteoarthritis of the hip or knee who had failed at least 3 months of non-operative treatment modalities. The indications for RTKA and RTHA were aseptic loosening, periprosthetic fracture, and polyethylene wear.

A retrospective chart review of the included patients was performed. Epidemiologic data was collected on the following patient characteristics; age at time of surgery, sex, body mass index (BMI), smoking status, hypertension, diabetes, heart disease, chronic obstructive pulmonary disease, rheumatoid arthritis, and lupus. We chose these characteristics because we considered them to be potential confounders for infection rate between groups. Age was recorded as a whole number in years. Obesity for this study was defined as BMI greater than 30 at the time of surgery. Sex, smoking status, diabetes, hypertension, chronic obstructive pulmonary disease, rheumatoid arthritis, and lupus were self-reported on patient intake forms which were scanned into the patient's chart. Heart disease was defined as a patient self-reporting coronary artery disease or history of a myocardial infarction. Blood urea nitrogen (BUN) and creatinine values were recorded on postoperative day 1 and reported as numerical values to the first decimal place to monitor for acute kidney injury postoperatively.

All TJA in both groups followed identical preoperative, periopertive, and postoperative protocols with regards to pain control, anesthesia, wound closure, and postoperative wound care. Patients undergoing primary arthroplasty received cefazolin preoperatively followed by three doses postoperatively. If patients were allergic to cefazolin they received clindamycin perioperatively in the same fashion. Patients undergoing revision arthroplasty received vancomycin preoperatively. Revision patients were kept on vancomycin until their intraoperative cultures were negative for growth at two days. If revision patients were allergic to vancomycin, they received clindamycin perioperatively. The procedures were performed by two orthopedic surgeons at our institution over a period of four years. Patients from January 1, 2012 to December 31, 2013 did not receive local antibiotics prior to surgical wound closure. Patients from January 1, 2014 to December 31, 2015 were treated with surgical wound providone-iodine lavage prior to permanent implant placement and administration of vancomycin powder in the surgical wound prior to closure of the joint capsule. The group that did not receive local antibiotics will from now on be referred to as the no-antibiotics group, and the group that received antibiotics will be referred to as the antibiotics group. For primary arthroplasty, prior to placement of final implants the antibiotics group's surgical wound was irrigated with 300 ml of providone-iodine and normal saline using a bulb syringe. The no-antibiotics group was irrigated with 300 ml of normal saline in the same fashion prior to final implant placement. For revision arthroplasty, prior to placement of final implants the antibiotics group was irrigated with 3 liters of providone-iodine and normal saline solution using a Pulsavac lavage system (Zimmer Biomet). The no-antibiotics group was irrigated with 3 liters of normal saline using a Pulsavac lavage system. The providone-iodine and saline solution was prepared using 15 ml providone-iodine per 1 l normal saline. This concentration was chosen based on a previous study that used providone-iodine to irrigate THA and TKA surgical wounds prior to implant placement. This study showed a decreased infection rate in the providone-iodine group.[11] After the permanent implants were placed and prior to capsule closure, the antibiotics group received 2 g of vancomycin powder evenly distributed throughout the surgical wound. The no-antibiotics group received no vancomycin powder prior to closure. Joint capsule, deep tissue, and skin closures were identical between groups. All wounds were dressed

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