

Antibiotic prophylaxis for total joint replacement surgery: results of a survey of Canadian orthopedic surgeons

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This paper was presented in its entirety in a podium presentation at the Annual Meeting of the Canadian Orthopedic Association, Halifax, NS, Jun. 1–3, 2007.

Accepted for publication
 Feb. 24, 2009

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Background: The role of perioperative antibiotic prophylaxis in total joint replacement (TJR) surgery is well established. Whereas guidelines have been published in some countries, in Canada controversy persists concerning the best clinical practice for perioperative antibiotic prophylaxis in TJR.

Methods: We conducted a survey of 590 practising orthopedic surgeons performing TJR in Canada to assess current antibiotic prophylaxis practice. The survey included questions pertaining to antibiotic prophylaxis indications, antibiotic choice, dosing, route and timing of administration in the primary and revision arthroplasty setting, as well as postoperative wound drainage evaluation and management.

Results: The response rate after 2 mail-outs was 410 of 590 (69.5%). Current antibiotic prophylaxis regimens varied widely among surgeons, underscoring the controversy that exists regarding what constitutes best clinical practice.

Conclusion: Opinions regarding use of perioperative antibiotic prophylaxis in TJR vary widely among orthopedic surgeons in Canada, illustrating the controversy as to what constitutes best clinical practice. This survey also points to a lack of consensus about the current management of postoperative wound drainage.

Contexte : Le rôle de la prophylaxie périopératoire aux antibiotiques dans l'arthroplastie totale est bien connu. On a publié des lignes directrices dans certains pays, mais au Canada, on ne s'entend toujours pas sur la meilleure pratique clinique en prophylaxie périopératoire aux antibiotiques dans le cas de l'arthroplastie totale.

Méthodes : Nous avons réalisé un sondage auprès de 590 chirurgiens orthopédiques actifs qui pratiquent des arthroplasties totales au Canada afin d'évaluer la pratique courante en matière de prophylaxie aux antibiotiques. Le sondage comportait des questions portant sur les indications de la prophylaxie aux antibiotiques, le choix d'antibiotique, la posologie, la voie et le moment de l'administration dans le contexte de la première arthroplastie et de l'intervention de révision, ainsi que l'évaluation et la prise en charge du drainage de la plaie après l'intervention.

Résultats : Le taux de réponse après 2 envois postaux s'est établi à 410 sur 590 (69,5 %). Les régimes courants de prophylaxie aux antibiotiques variaient énormément entre les chirurgiens, ce qui souligne la controverse qui existe au sujet de ce qui constitue la meilleure pratique clinique.

Conclusion : Les opinions au sujet de l'utilisation de la prophylaxie périopératoire aux antibiotiques dans le cas de l'arthroplastie totale varient énormément entre les chirurgiens orthopédiques au Canada, ce qui illustre la controverse quant à ce qui constitue la meilleure pratique clinique. Ce sondage révèle aussi qu'il n'y a pas de consensus sur la prise en charge actuelle du drainage de la plaie après l'intervention.

The role of perioperative antibiotic prophylaxis in total joint replacement (TJR) surgery is well established.^{1,2} Whereas national guidelines have been published in some countries, controversy persists in Canada concerning best clinical practice for perioperative antibiotic prophylaxis in TJR. We therefore surveyed orthopedic surgeons performing TJR in Canada during fiscal year 2004/05 to assess the most common perioperative antibiotic prophylaxis practice.

METHODS

We conducted a survey of 590 practising Canadian orthopedic surgeons. Three orthopedic surgeons and 1 infectious diseases specialist developed and established the content of the survey. The survey was mailed to surgeons and remained to nonresponders after 12 weeks. Only practising TJR orthopedic surgeons, identified through the Royal College of Physicians and Surgeons of Canada online database, were asked to complete the survey.

The Total Joint Replacement Antibiotic Prophylaxis Survey included 27 questions pertaining to prophylaxis indications, antibiotic choice, dosing, route and timing of administration in the primary and revision arthroplasty setting for hips and knees, as well as postoperative wound drainage evaluation and management (Appendix 1).

We analyzed survey responses using descriptive statistics. Differences, if any, in responses among high-, mid- and low-volume surgeons were analyzed using the χ^2 test for proportions.

RESULTS

The response rate for the survey after 2 mail-outs was 410 of 590 (69.5%). Of responding surgeons, 47 of 410 (11.5%) were categorized as high volume, performing over 200 TJRs per year; 325 of 410 (79.2%) were categorized as midvolume, performing 25–200 TJRs per year; and 38 of 410 (9.3%) were categorized as low volume, performing fewer than 25 TJRs per year. We identified no significant differences regarding antibiotic prophylactic practices among these 3 groups. Of responders, 96.6% indicated routine use of systemic prophylactic antibiotics for uncomplicated primary TJR. Three responders stated that they did not routinely administer systemic prophylactic antibiotics for primary TJR.

Cefazolin was the most commonly prescribed antibiotic (97.3%). Vancomycin was also prescribed by 26% of responders either as their first choice or if the patient had a history of an allergy to penicillin. Of responders, 48.5% reported administering the antibiotic chosen in the operating suite, and 90% estimated that the prophylactic antibiotic was routinely administered within less than 60 minutes before skin incision. Ninety-one percent of responders reported use of a standard dose of antibiotic for all patients, only 7.5% adjusted the dose depending on patients' weight and 1.5% were undecided. A dose of 1 g was the most common cefazolin dosage (70.2%), with only 29.8% using a dosage of 2 g. For vancomycin, 95% chose a 1-g dose, with 5% adjusting the dose depending on individual patient issues. Postoperative prophylaxis duration varied widely, with 42% preferring 24 hours.

In the event of cement being chosen for implant fixation in primary TJR, only 48.3% of responders stated that they use antibiotic-loaded cement (ABLC). In addition, of this

group, 96% chose to use commercially prepared ABLC, with the remainder opting to mix antibiotic into the cement themselves. There was no consensus regarding the choice of antibiotic in this latter setting. Of the group using ABLC, 67% of surgeons stated that they choose ABLC for all primary TJR procedures, whereas 33% indicated use for "high-infection risk" patients only.

In the clinical scenario of persistent serous wound drainage within 1 week postoperative in the absence of redness or fever, only 33.5% of responding surgeons indicated that they would routinely obtain a wound culture. In this setting, 23.5% of responders used diagnostic ultrasonography to assess the patient for possible deep fluid collections. Of responding surgeons, 16.4% indicated that they would routinely take the patient back to the operating suite for wound exploration should wound drainage persist beyond postoperative day 4. Sixty percent of responding surgeons stated that they would discharge patients from hospital with persistent wound drainage. When asked about the use of antibiotics in this latter setting, 32.5% stated they would not prescribe extended prophylactic antibiotic therapy, 21.5% stated they would always prescribe extended prophylaxis, and 46% indicated a variable or individualized practice. In the event of prescribing extended therapy, 96% of prescribers chose oral antibiotics, with the majority (84%) opting for a 5–10 day course and 16% choosing to continue therapy until drainage has ceased.

In the setting of revision TJR, 63.9% of responders stated that they routinely withhold prophylactic antibiotics until they have obtained a deep-tissue specimen for culture. A total of 13.4% were undecided regarding this issue. When considering a suspicion of septic failure preoperatively necessitating revision surgery, 66% routinely withheld prophylactic antibiotics until they had obtained a deep specimen for culture. If the preoperative diagnosis was clearly aseptic failure, then only 28% routinely withheld preoperative antibiotics until after obtaining deep cultures.

Seventy-four percent of responding surgeons use the same antibiotic choice and dosage for both primary and revision procedures, whereas 14% indicated a switch from cefazolin to vancomycin, with or without gentamicin or tobramycin, in revision TJR. Forty percent of surgeons opt for the same duration of antibiotic prophylaxis for revision TJR as with primary procedures. Of responders, 25.5% indicated longer duration of prophylaxis, 48–72 hours' postoperative duration as compared with only 24 hours, whereas 34.5% continue prophylaxis until the intraoperative culture results are known.

DISCUSSION

The use of prophylactic antibiotics in primary joint replacement surgery is considered the standard of practice according to the 2003 National Institutes of Health (NIH) Consensus Statement.³ Despite this statement and available

supporting data, 3 surgeons in our survey indicated that they do not routinely use prophylactic antibiotics. Quenon and colleagues⁴ showed that the relative risk for deep infection was increased in those patients who did not receive perioperative antibiotics. Large observational joint registries have also shown reduced revision rates with systemic antibiotic prophylaxis.⁵

This study describes Canadian orthopedic surgeons' preferences for antibiotic prophylaxis for TJR surgery. Although no national Canadian guidelines for prophylaxis have been promulgated, it would appear that antibiotic prophylaxis practice for TJRs is relatively uniform with regard to the antibiotic of choice and dose administered. Our survey showed that most Canadian surgeons favour a first-generation cephalosporin; however, the dose most frequently used was 1 g, whereas the literature seems to support the use of a larger dose of 2 g intravenously.^{6,7} Further, Bratzler and Houck, writing for the Surgical Infection Prevention Guidelines Writers Workgroup,² have advised that the initial antimicrobial dose should be adequate based on the patient's body weight, adjusted dosing weight or body mass index.

In the current study, surgeon volume did not seem to be a factor influencing decisions regarding prophylaxis. Most studies in the literature do support the fact that clinical outcomes are improved by high-volume arthroplasty surgeons.⁸⁻¹² However, only 1 study reported fewer deep infections with high-volume surgeons, and no clear data were provided to suggest that this was related to a difference in antibiotic prophylaxis.¹³ Our survey suggests that management decisions regarding infection prophylaxis do not differ between low- and high-volume arthroplasty surgeons in Canada. We did not survey for any difference in outcomes between these groups.

There are ample data in the literature to support the opinion that orthopedic surgeons do not consistently implement ideal antibiotic prophylactic measures. For the most part, this seems to focus around inappropriate timing of antibiotic delivery as well as duration of administration.^{4,14-17} Recent studies suggest that the optimum timing for the preoperative antibiotic dose should be within less than 1 hour of skin incision and extended postoperatively for a duration of 24 hours.¹⁸ In our survey, 90% of surgeons stated that antibiotic prophylaxis was given within 1 hour of skin incision. Whereas this response reflects opinion and may be subject to bias, it should be noted that 48% reported administering antibiotics in the operating room, which has indeed been shown to dramatically improve the likelihood of this occurring within less than 1 hour before incision.¹⁹

Our survey showed no consensus among responding surgeons regarding duration of administration for prophylactic antibiotics. Only 42% choose a 24-hour regimen of intravenous antibiotic prophylaxis, despite numerous reported studies that support this practice with no additional value to more prolonged therapy.^{2,20-23}

Antibiotic-loaded cement has been advocated in prophylactic

lactic doses when a cemented implant fixation is used in routine TJR to reduce the risk of infection, and has also been shown to reduce the rate of revision surgery in large national registries.^{5,9,24} Others have expressed concerns about the emergence of resistant organisms, allergic reactions and cost as reasons to avoid the use of ABLC for routine TJR.²⁵ Some have suggested its use be reserved for high-risk cases, which includes revision TJR surgery.^{25,26} There are differing opinions about the routine use of ABLC in the literature, and this is also evident from our survey, with a fairly even mix of surgeons supporting the 3 possible approaches. Premixed commercial antibiotic cement preparations have superior mechanical and elution properties relative to hand-mixed ABLC, and most Canadian surgeons using ABLC support this practice.²⁶

There was no consensus as to which antibiotic is best in ABLC, and this is again reflected by a lack of consensus in the literature, although gentamicin seems to be the most widely used.²⁶ Tobramycin is the most widely used in the United States, since it is more readily available in a powdered form and perhaps may be less detrimental to the mechanical properties of polymethylmethacrylate, as opposed to a gentamicin liquid preparation.^{25,27} Cefuroxime has also been used in bone cement effectively to reduce arthroplasty-related infections in a randomized controlled trial.²⁸

Several authors have shown a link between prolonged serous wound drainage and subsequent deep and superficial wound infections.²⁹⁻³¹ There is a paucity of data in the literature concerning the management of asymptomatic wound drainage following TJR. This issue is separate from that of antibiotic prophylaxis, but given the lack of any firm guidelines on this problem, we hoped our survey would help inform further regarding current practice. Some studies have suggested that swabbing of a serous draining wound may cloud and delay the diagnosis.³² Only about one-third of responding surgeons reported that they would swab a persistent draining wound without fever or local redness/erythema. The use of an antibiotic for asymptomatic serous wound drainage and duration is disputed.^{30,32-34}

In our survey, the majority of surgeons (60%) would discharge patients home with a serous draining wound if asymptomatic, and two-thirds of surgeons would prescribe antibiotics for draining wounds at least some of the time. All wounds have some degree of hematoma postoperatively, and it is unclear in the literature what size of hematoma predisposes patients to an increased risk for infection. Saleh and colleagues³⁰ diagnosed "hematoma" as opposed to "hemarthrosis" based on clinical palpation of fluid and local tenderness to touch, both of which are purely subjective measures. Some authors advocate returning the patient to the operating suite for irrigation, débridement and closure of the wound if drainage persists beyond 5-7 days postoperatively.^{30,33,34} If and when operative evacuation of a hematoma should be entertained is unclear, as reflected by the small number of Canadian surgeons

(16%) who return patients to the operating suite for an otherwise asymptomatic draining wound beyond 4 days.

There are few data in the literature to guide antibiotic prophylaxis in the revision setting. In general, if the diagnosis of infection is in question at the time of surgery, the practice of withholding preoperative antibiotics to improve the yield of intraoperative soft tissue and bone cultures remains controversial. Recently, Ghanem and colleagues³⁵ concluded that the administration of preoperative antibiotics to patients with a positive preoperative joint aspirate did not interfere with the isolation of the infecting organism.

Similarly, if the erythrocyte sedimentation rate and C-reactive protein levels are normal preoperatively, then the chance of infection is very low,^{36,37} and antibiotic prophylaxis may be administered. Also, if the diagnosis of infection has already been made and the organism isolated, it seems reasonable and appropriate to administer preoperative antibiotics. With this in mind, most surgeons in our survey withhold preoperative antibiotics if there is any suspicion of infection, and most give preoperative antibiotics if the probability of infection is felt to be low. Most surgeons opt to use the same antibiotics for revision procedures as used in the primary setting, and this seems reasonable given the lack of available data that would suggest changing the antibiotic prophylaxis.

CONCLUSION

Opinions regarding use of perioperative antibiotic prophylaxis in TJR vary widely among orthopedic surgeons in Canada, illustrating the controversy as to what constitutes best clinical practice. This survey also illustrates that current management of asymptomatic postoperative wound drainage is not uniform. At present there remains a lack of available management guidelines pertinent to this issue. The use of prophylactic antibiotics is clearly the standard of practice in Canada. We identified variation regarding the choice of antibiotic as well as dose and duration thereof. The substantial majority of respondents reported timing of administration within 1 hour of incision, and the practice of administration in the operating room (for antibiotics that can be rapidly infused), as reported by

almost one-half the respondents, should be encouraged, as this likely contributes to the former.

Based on our review of the literature and the results of our survey, our suggestions are 2-fold. First, that all Canadian arthroplasty surgeons should be encouraged to actively participate in the national Canadian Joint Replacement Registry, as collection of this information with respect to antibiotic prophylaxis would help delineate practice across the spectrum of surgeons and procedures, and assist with recommendations for improvement in patient care. Second, we encourage all surgeons to adhere to the American Academy of Orthopaedic Surgeons² recommended guidelines for antibiotic prophylaxis for total joint arthroplasty (Box 1). With specific regard to the question of dosing, we would recommend adherence to the guidelines as published by The French Society of Anesthesia and Resuscitation³⁸ (Box 1).

Acknowledgement: This survey study was supported by a research grant received from Hip Hip Hooray.

Competing interests: None declared.

Contributors: Drs. de Beer, Rotstein, Weening and Winemaker, and Ms. Petrucci designed the study. Ms. Petrucci, Dr. Weening and Ms. Royston acquired the data, which Drs. de Beer, Rotstein, Weening and Winemaker and Ms. Petrucci analyzed. Drs. de Beer, Rotstein and Winemaker, and Ms. Petrucci wrote the article, which Drs. de Beer, Weening and Winemaker and Ms. Petrucci and Ms. Royston reviewed. All authors approved the article for publication.

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Box 1. Recommendations for antibiotic prophylaxis in total joint replacement surgery

- Cefazolin or cefuroxime²
- Clindamycin or vancomycin if confirmed penicillin allergy²
- IV start within 1 hour of incision (within 2 h for vancomycin)²
- Infuse completely before tourniquet inflation²
- If weight > 80 kg, double dose for cefazolin²
- Additional dose if operating time exceeds 2–4 hours (6–12 h for vancomycin) or there is “significant” blood loss²
- Duration should not exceed 24 hours postoperative²
- Dosage: 2 g cefazolin, 1.5 g cefuroxime, 15 mg/kg vancomycin³⁸

IV = intravenous.

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Appendix 1. Total Joint Replacement Antibiotic Prophylaxis Survey

1. Please indicate the number of primary total hip and total knee replacement surgeries you performed in fiscal year 2004/05.
 Total hip < 25 25-50 50-100 100-200 > 200
 Total knee < 25 25-50 50-100 100-200 > 200
2. Do you routinely use systemic antibiotic prophylaxis in total joint replacement (TJR) surgery? Yes No
3. Please indicate the antibiotic drug(s) you most commonly use per procedure and dosage (check all that apply).
 vancomycin 1 g other gentamicin 80 mg 240 g
 cefazolin (Ancef) 1 g 2 g tobramycin 80 mg 240 mg
 cefuroxime 750 mg 1.5 g other drug other dosage
4. Is the dosage of perioperative antibiotic given a standard dose or adjusted for weight (mg/kg)? standard mg/kg
5. At which point of care is the antibiotic administered?
 same day surgery unit patient receiving area surgical suite other
6. Please estimate mean timing for when the prophylactic agent is administered, relative to when the skin incision is made (e.g., 1 h prior to skin incision).
 < 30 min 30-60 min 61-120 min > 120 min
7. For cemented primary TJR, is antibiotic included in the cement? Yes No **(if no, go to question #11)**
8. Is the antibiotic included for all cemented cases or for high-risk cases only (i.e., diabetic)?
 all cemented cases high-risk cases only
9. If you use prophylactic antibiotics in cemented cases, please indicate the antibiotic used.
 surgeon-mixed, drug: _____ dose/bag of cement: _____
 premixed commercially available product, specify: _____
10. Does your antibiotic prophylaxis regimen differ between total hip and total knee arthroplasty cases?
 Yes No If yes, please explain: _____
11. Postoperatively, how many doses are given and what is the usual duration of the prophylaxis?
 Dose: _____ Duration: _____

The following questions are specific to persistent serous wound drainage postoperative without redness, warmth or fever.

12. Do you ever culture serous drainage without the presence of redness, warmth or fever in the first week following surgery? Yes No
13. Do you ever assess wounds for fluid collections via an ultrasound? Yes No
14. If persistent serous wound drainage at or beyond postoperative day 4, do you take the patient back to the operating room? Yes No
15. Do you allow patients to go home with serous wound drainage? Yes No
16. Do you prescribe antibiotics if patient is discharged home with a draining wound? Always Sometimes No
(if no, go to question #18)
17. If you prescribe antibiotics for patient discharged with a draining wound, please specify type and duration.
 oral antibiotics Duration: _____
 IV antibiotics Duration: _____
18. Do you have a surgical site infection surveillance program at your hospital? Yes No Unsure
(if no or unsure, go to question #21)
19. Who manages the surgical site infection surveillance program at your hospital?
 Please specify: _____
20. Is the data provided by your surgical site infection surveillance program useful? Yes No

The following questions are specific to revision TJR surgery only.

21. Please indicate the number of revision total hip and total knee replacement surgeries you performed in fiscal year 2004/05.
 Revision total hip arthroplasty < 10 10-25 25-50 > 50
 Revision total knee arthroplasty < 10 10-25 25-50 > 50
22. Do you ever withhold antibiotics prior to obtaining deep tissue specimens in revision TJR? Yes No
23. If you withhold antibiotics prior to obtaining deep tissue specimens in revision TJR, for which cases?
 query infection aseptic loosening implant wear fracture
24. Does your antibiotic choice for revision TJR surgery differ from primary TJR surgery? Yes No
(if no, go to question #26)
25. If your antibiotic choice differs from primary surgery, which antibiotic(s) and dose?
 Drug: _____ Dose: _____
26. If you use prophylactic antibiotics in cemented cases in the revision setting, please indicate antibiotic used.
 surgeon-mixed, drug: _____ dose/bag of cement: _____
 premixed commercially available product, specify: _____
27. For revision cases, how long do you continue prophylactic antibiotics postoperatively?
 as per primary case longer than primary case until culture results are available

Thank you for your time to complete this questionnaire.
 Please return the questionnaire in the self-addressed, stamped envelope provided.