

Evidence Review



Topic: Prophylactics Antibiotic Use in Hip and Knee Arthroplasty

Introduction

Antibiotic prophylaxis following hip or knee replacement surgery is currently recommended for use in the ABJHI care path for infection prevention. There have, however, been questions surrounding provincial inconsistency with weight-based dosing recommendations. The intent of this evidence review is to summarize the best available evidence related to the weight-based dosing of prophylactic antibiotics in hip and knee replacement surgery.

Background

Infection is one of the most devastating complications following TJA. Approximately 1-5% of TJA procedures develop deep or superficial infection¹, with total knee replacements having slightly higher risk compared to total hip replacements.

Search Strategy

A search of the **Cochrane Database of Systemic Reviews** was conducted with the following search strategy:

Search Term: (Antibiotic prophylaxis) AND (Arthroplasty OR joint replacement)

A search of **PubMed, EMBASE, CINAHL and Medline** was conducted with the following strategy:

Search Term: (antibiotic prophylaxis OR antimicrobial prophylaxis) AND (arthroplasty OR joint replacement) AND (dose OR dosage OR dosing)

A **Grey literature** search was completed to acquire guidelines from professional societies and government agencies.

Inclusion Criteria

- Primary studies (Randomized Controlled Trials, Case Control, Case Series, Comparative Studies)
- Secondary studies (Systematic Reviews, Meta-analyses)

Exclusion Criteria

- Surveys
- Expert Opinion

Articles Considered:

1. AlBuhairun, B, Hind, D, Hutchinson, A. Antibiotic Prophylaxis for wound infections in total joint arthroplasty: a systemic review. *Journal of Bone and Joint Surgery Br.* 2008 Jul; 90(7):915-9.
2. Bedouch P, Labarère J, Chirpaz E, Allenet B, Lepape A, Fourny M, Pavese P, Girardet P, Merloz P, Saragaglia D, Calop J, Francois P. Compliance with guidelines on antibiotic prophylaxis in total hip replacement surgery: results of a retrospective study of 416 patients in a teaching hospital. *Infect Control Hosp Epidemiol.* 2004 Apr;25(4):302
3. Bhattacharyya T; Hooper DC; *Journal of Bone & Joint Surgery, American Volume*, 2007 Feb; 89A (2): 287-91
4. Bratzler DW, Houck PM, Richards C, Steele L, Dellinger EP, Fry DE, Wright C, Ma A, Carr K, Red L. Use of antimicrobial prophylaxis for major surgery: baseline results from the National Surgical Infection Prevention Project. *Arch Surg.* 2005 Feb;140(2):174-82.

Guidelines Considered:

1. Antibiotic prophylaxis in surgery. A national clinical guideline. July 2008. NHS QIS. Scottish Intercollegiate Guidelines Network. Edinburgh: SIGN, July 2000. www.sign.ac.uk
2. Primary Hip Replacement: a guide to good practise. August 2006. British Orthopaedic Association
3. The Hospital Infection Control Practices Committee. National Center for Infectious Diseases Centers for Disease Control and Prevention. Public Health Service US Department of Health and Human Services. Mangram A, Horan TC, Pearson ML, Silver LC, Jarvis WR. 1999. Guideline for Prevention of Surgical Site Infection, 1999. *Infection Control and Hospital Epidemiology*, Vo. 20 No. 4, 247-269.
4. Bugs and Drugs 2006 Capital Health. Blondel-Hill E, Fryters S. www.bugsanddrugs.ca

Excluded Sources:

1. Edmiston CE, Hennen C, Nakeeb A, Wallace J. Perioperative Antibiotic prophylaxis in the gastric bypass patient: Do we achieve therapeutic levels? *Surgery* October 2004 738-747.—population not relevant
2. Engelman R, Shahian D, Shemin R, Guy TS, Bratzler D, Edward F, Jacobs M, Hiran F, Bridges C. The Society of Thoracic Surgeons Practice Guideline Series: antibiotic prophylaxis in cardiac surgery, part II: antibiotic choice. *Ann Thorac Surg* 2007; 83:1569-76—population not relevant.
3. Ansari A; Kamalasekaran S; *European Journal of Orthopaedic Surgery & Traumatology*, 2009 Jan; 19 (1): 23-6 - survey
4. Choi WS; Song JY; Hwang JH; Kim NS; Cheong HJ; *Infection Control & Hospital Epidemiology*, 2007 Aug; 28 (8): 997-1002—survey
7. Pillai A; Atiya S; *Quality in Primary Care*, 2004; 12 (2): 103-7—survey
8. Starks I; Carmont M; Roberts PJ; *Journal of Hospital Infection*, 2007 Jun; 66 (2): 186-7—expert opinion
9. Zoutman D, Chau L, Watterson J, MacKenzie T, Djurfeldt M. A Canadian Survey of Prophylactic Antibiotic Use Among Hip Fracture Patients - survey

Results

AlBuharian et al (2008)¹ completed a systematic review of antibiotic prophylaxis in hip and knee replacement patients. They found no significant difference in the effectiveness of cephalosporins versus teicoplanin or penicillin-derivatives. Nor was there evidence that a particular generation of cephalosporin was superior. Finally, there was no clinical difference between systemic administration versus use of antibiotic impregnated cement. The review did not explore optimal dosages or durations of antibiotic prophylaxis.

Bratzler et al (2005)² reviewed the guidelines identified by the Surgical Infection Prevention Guideline Writers Workgroup in conjunction with the January 2003 Medical National Surgical Infection Prevention Project. Cephalosporins (cefazolin or cefuroxime) were identified as the agent of choice for antibiotic prophylaxis in hip and knee arthroplasty. For patients with a serious beta-lactam allergy or adverse reaction, vancomycin or clindamycin were suggested with consideration of local antimicrobial resistance patterns. The group agreed that the antibiotic should be completely infused prior to inflation of tourniquet (if used), however, there was no consensus regarding whether the infusion needs to be completed prior to incision. Administration of prophylaxis should be within 60 minutes of incision and discontinued within 24 hours from the end of surgery. For patients with known methicillin-resistant staphylococcus aureus (MRSA), vancomycin was identified as the

appropriate agent.

This article suggested dose adjustment based on body size with administration repeated intraoperatively if surgery is still in progress more than two half lives after first dose. The following table is adapted from Bratzler et al and provides commonly used prophylactic practices.

Antibiotic	Infusion Duration	Standard Dose	Wt Based Dose	Redose Interval
Cefazolin	3-5 min direct IV or 15-60 min intermittent IV	1-2 g	20-30mg/kg (<80kg give 1g, >80kg give 2g)	2-5 hours
Cefuroxime	3-5 min direct IV or 15-60 min intermittent IV	1.5g	50mg/kg	3-4 hours
Clindamycin	10-60 min (do not exceed 30mg/min)	600-900mg	If >10kg, use 3-6mg/kg	3-6 hours
Vancomycin	1g over 60 min (longer infusion if >1g used)	1g	10-15mg/kg	6-12 hours

This guideline attempts to provide effective, safe and economical prophylaxis without promoting antimicrobial resistant bacteria. The authors cautioned that their recommendations are based on dated studies and that prospective monitoring of literature is important since antimicrobial susceptibilities change with time.

Bedouch et al (2004)³ reviewed compliance with the French Society of Anaesthesiology and Intensive Care guidelines on antibiotic prophylaxis for total hip replacements. Weight specific dosing was not addressed. The author refers to the French guideline's support antibiotic prophylaxis for all total hip replacements. Cephalosporin (cefazolin, cefuroxime or cefamanadole) was the agent of choice with vancomycin recommended for patients with previous allergic reaction to beta-lactam antibiotics or a high risk or proven carriage of MRSA. Prophylaxis is to be administered 30-60 minutes prior to incision (90-120 minutes for vancomycin). Duration of prophylaxis should not exceed 48 hours. The authors found large variation in practice and suggested improved dissemination of guidelines.

Bhattacharyya et al (2007)⁴ reviewed the timing of antibiotic prophylaxis. Delivery within 60 minutes of incision was considered ideal. This author commented that while antibiotic prophylaxis is well supported in the literature, "the evidence supporting administration of antibiotics within one hour before surgery is not as strong." (pg 290). The author offered no comment regarding the efficacy of weight adjusted antibiotic prophylaxis.

SIGN (Scottish Intercollegiate Guidelines Network)⁵ provides recommendations on prophylactic antibiotic use as follows:

- “A single standard therapeutic dose of antibiotic is sufficient for prophylaxis under most circumstances.” (page 31)
- “In arthroplasty there is evidence from a very large observational cohort that 24 hours of antimicrobial prophylaxis is associated with lower rates of re-operation than a single dose. Up to 24 hours of antibiotic prophylaxis should be considered for arthroplasty.” (page 31)

SIGN suggests that selection of antibiotic agent be made at a local level. “Local antibiotic policy makers have the experience and information to make recommendations about specific drug regimens...The choice of antibiotics should take into account local resistance patterns.” (page 29)

Neither SIGN, the British Orthopaedic Association⁶ or the US Department of Health and Human Services⁷ comment on weight adjusted antibiotic dosing.

Bugs and Drugs (2006)⁸, a guideline for Capital Health, recommends increasing the dose of cefazolin from 1g to 2g for patients greater than 100kg.

Summary

This rapid review found limited empirical evidence related to weight adjusted dosing of prophylactic antibiotics in joint replacement surgery. General consensus regarding the type (cephalosporins), timing, redosing intervals and duration of prophylactic antibiotic administration exists. Many authors noted a lack of standardized guidelines. Even in jurisdictions where guidelines were available, widespread variance in practical application of antibiotic prophylaxis was commonly noted.

A search for practise guidelines (government and professional societies) failed to yield clear direction for the appropriate weight-based dosing of prophylactic antibiotics in orthopaedic surgery.

The current care path recommends increasing the dose of cefazolin from 1g to 2g for patients who weigh more than 80kg. This recommendation is consistent with Bratzler et al (2004). In consultation with the Alberta Hip and Knee Care Path users, in practise, some locations increase dosages for patients >100kg. There was little clinical evidence found to support or refute either of these prophylactic regimens.

Clinical Committee Comment

On October 15, 2009 the Hip and Knee Clinical Committee discussed the findings of the evidence review. Committee members agreed that based on inconclusive findings in the literature and inconsistent practices provincially, weight-based dosing recommendations for Cefazolin should be removed with dosing adjustment at the surgeon's discretion.

Care Path Recommendation

All references to weight based dosing recommendations for Cefazolin are to be removed with dosing adjustments at the surgeon's discretion for the 2009 release of the Hip and Knee Care Path.

References

1. AlBuhairun, B, Hind, D, Hutchinson, A. Antibiotic Prophylaxis for wound infections in total joint arthroplasty: a systemic review. *Journal of Bone and Joint Surgery Br.* 2008 Jul; 90(7):915-9.
2. Bedouch P, Labarère J, Chirpaz E, Allenet B, Lepape A, Fourny M, Pavese P, Girardet P, Merloz P, Saragaglia D, Calop J, Francois P. Compliance with guidelines on antibiotic prophylaxis in total hip replacement surgery: results of a retrospective study of 416 patients in a teaching hospital. *Infect Control Hosp Epidemiol.* 2004 Apr;25(4):302
3. Bhattacharyya T; Hooper DC; *Journal of Bone & Joint Surgery, American Volume*, 2007 Feb; 89A (2): 287-91
4. Bratzler DW, Houck PM, Richards C, Steele L, Dellinger EP, Fry DE, Wright C, Ma A, Carr K, Red L. Use of antimicrobial prophylaxis for major surgery: baseline results from the National Surgical Infection Prevention Project. *Arch Surg.* 2005 Feb;140(2):174-82.
5. Antibiotic prophylaxis in surgery. A national clinical guideline. July 2008. NHS QIS. Scottish Intercollegiate Guidelines Network. Edinburgh: SIGN, July 2000. www.sign.ac.uk
6. Primary Hip Replacement: a guide to good practise. August 2006. British Orthopaedic Association
7. The Hospital Infection Control Practices Committee. National Center for Infectious Diseases Centers for Disease Control and Prevention. Public Health Service US Department of Health and Human Services. Mangram A, Horan TC, Pearson ML, Silver LC, Jarvis WR. 1999. Guideline for Prevention of Surgical Site Infection, 1999. *Infection Control and Hospital Epidemiology*, Vo. 20 No. 4, 247-269.
8. Bugs and Drugs 2006 Capital Health. Blondel-Hill E, Fryters S. www.bugsanddrugs.ca

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