

Blood Cultures for Evaluation of Fever After Total Joint Arthroplasty

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Abstract

Fever after total joint arthroplasty (TJA) is common. Fearing the potential complications of bacteremia, physicians often obtain blood cultures to evaluate fever after TJA.

In this study, we retrospectively examined the results of 102 sets (204 samples) of blood cultures that had been obtained from 50 patients (mean age, 67.3 years) during the first 2 postoperative days for evaluation of fever of 38.3°C or higher. All patients had been receiving antibiotic prophylaxis. Of the 50 patients, 39 had undergone total knee arthroplasty, and 11 had undergone total hip arthroplasty. There had been 49 primary operations and 1 revision.

Of the 204 blood culture samples, none had grown a pathogen. The cultures had been ordered by both surgical (61%) and medical (39%) services. The 2008 institution charge to process the 2 blood culture samples (1 set) routinely collected for each evaluation was \$120 (true cost, \$44.29). Therefore, in the current health care market, the charge to the payer for processing 102 sets would be \$12,240.

We conclude that blood cultures are neither useful nor cost-effective in evaluating fever immediately after TJA. We believe that the results of this study will be helpful to both orthopedists and medical consultants involved in the care of TJA patients.

Fever after total joint arthroplasty (TJA) is common. The literature^{1,2} supports this as a normal physiologic response that occurs most often during the first 2 postoperative days. However, the point at which elevated temperature becomes a concern has not been elucidated. Recently, the current dilemma was well articulated: "It appears that to use health care resources more

efficiently, surgeons should use a threshold other than fever alone when ordering blood cultures. Current available data is insufficient to support altering the threshold entirely because the consequences of missing the diagnosis of bacteremia can be severe."³ In light of the situation just described, it is not surprising that health care providers often feel compelled to order blood cultures when evaluating fever in TJA patients.

Although the general surgery and obstetrics/gynecology literature include studies that can help guide its practitioners,⁴⁻⁷ there is a paucity of data in the orthopedic literature. The number of patients from whom blood cultures were obtained often was too small to draw conclusions concerning use of blood cultures in evaluating fever after joint replacement surgery.^{1,2}

MATERIALS AND METHODS

The medical records of 3,607 patients who underwent either total hip arthroplasty (THA) or total knee arthroplasty (TKA) at 3 local hospitals were reviewed. From 2 of the centers, records were obtained from January 1, 1995, until September 30, 2001. The records from January 1, 1998, until September 30, 2001, were obtained from the third center.

Inclusion criteria for the study were (1) primary or revision THA or TKA, (2) oral temperature of 38.3°C (101°F) or higher during the first 2 postoperative days, (3) use of prophylactic antibiotics, (4) at least 2 sets (2 samples per set, 1 aerobic and 1 anaerobic) of blood cultures obtained for each febrile episode, (5) no previous history of prosthetic infection, and (6) clear documentation of blood culture results.

Of the 3,607 patients who underwent TJA, 50 met the inclusion criteria. We did not document how many of the 3,557 excluded patients had fevers, but no blood cultures were ordered. Blood cultures were obtained for 51 febrile episodes among the 50 included patients. Two sets of cultures (2 samples per set) were obtained for each febrile episode, for a total of 204 samples. It is common practice to obtain aerobic and anaerobic blood culture specimens to determine the etiology of a febrile episode. It was and is routine to draw 2 sets of blood cultures, historically waiting 30 minutes between the 2 draws and more recently drawing the 2 sets back to back from different sites using sterile technique.

Blood cultures were drawn on day of surgery in 4 cases, on postoperative day 1 in 23 cases, and on postoperative day 2 in 24 cases. There were 27 men (54%) and 23 women (46%). Mean age was 67.3 years (range, 39-91

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years). Thirty-nine patients (78%) underwent TKA, and 11 (22%) underwent THA.

There were 49 primary operations and 1 revision. The revision was an acetabular revision for aseptic loosening. All patients were receiving prophylactic cefazolin. One patient was receiving nitrofurantoin for a urinary tract infection (UTI) diagnosed before the TJA. Forty-five (90%) of the patients had a primary diagnosis of osteoarthritis, 2 had rheumatoid arthritis, and 3 had avascular necrosis (1 involving the femoral head, 2 involving the medial femoral condyle).

Presence of diabetes mellitus and chronic prednisone use were documented. Twenty percent (10 patients) were diabetic, and 12% (6 patients) were receiving prednisone. Of the patients receiving prednisone, 1 was a kidney transplant recipient, 2 had systemic lupus erythematosus, 1 had rheumatoid arthritis, 1 had polymyalgia rheumatica, and 1 had chronic obstructive pulmonary disease.

RESULTS

Of the 204 samples, none grew a pathogen. Mean temperature was 39.1°C or 102.3°F (range, 38.3°C–41.8°C or 101°F–107.2°F). In no instance was a definitive cause of fever identified. However, atelectasis was often designated as the etiology.

Attending medical consultants ordered 15 (29%) of the 51 blood cultures, attending orthopedic surgeons ordered 14 (27%), and the other 22 cultures were ordered by the orthopedic physician assistant (9 cases), the orthopedic surgery resident (6 cases), the medical consultant's resident (3 cases), the medical consultant's physician assistant (2 cases), and the surgical resident on orthopedic surgery call (2 cases). Overall, 61% of the cultures were obtained from the orthopedic service, and the other 39% from the medical service.

At most recent inquiry (2008), institution charges to the individual payer for processing the 4 blood culture samples (2 sets) routinely collected for each evaluation was \$240 (true cost, \$88.58). Therefore, in the current health care market, the charge to the payer for processing 102 sets would be \$12,240.

DISCUSSION

Our study results clearly demonstrate that blood cultures were not useful for evaluating fever during the first 2 days after TJA, when the patient was receiving antibiotic prophylaxis and a bloodstream infection was not suspect. This was true despite the fact that a significant proportion of the patients in the study had comorbidities known to be immunosuppressive—a factor found by Theuer and colleagues⁷ to increase the likelihood of a positive culture. Furthermore, our patients' mean temperature (39.1°C) was higher than what has been reported in the orthopedic literature. Kennedy and colleagues¹ reported a temperature of 39°C or higher in only 17% of their patients.

Although studies in the nonorthopedic literature⁴⁻⁷ and orthopedic literature^{1,2,8-10} have suggested the same con-

clusion, the number of patients in the orthopedic literature has been small. Shaw and Chung² evaluated 100 THA patients and 100 TKA patients and noted that maximum postoperative temperature occurred on postoperative days 1 and 2 and gradually returned to normal by postoperative day 5. Blood cultures, obtained from only 5 patients, were all negative. All patients received postoperative antibiotic prophylaxis for 48 hours. Furthermore, patients with human immunodeficiency virus infection or another "immunocompromising" disease were excluded. Shaw and Chung did not mention which postoperative day the blood cultures were obtained and did not record the temperature when cultures were obtained or the patients' comorbidities. They concluded that a workup for sepsis was not indicated for evaluating postoperative pyrexia alone and that clinical assessment of the patient should also be part of the decision making.

Kennedy and colleagues¹ retrospectively evaluated 92 patients who had undergone TKA. Ten patients with pre-existing chronic disease or malignancy were excluded. Their mean postoperative axillary temperature was 38.3°C (101°F). Maximum temperature occurred most often on postoperative day 2. All patients received antibiotic prophylaxis for 24 hours after surgery. Blood cultures were obtained on 16 patients with a postoperative temperature of higher than 39°C (102.2°F). None of these cultures was positive. Kennedy and colleagues concluded that fever during the first 5 postoperative days does not necessarily indicate an infective focus. They found that the most significant predictor of temperature higher than 39°C (102.2°F) was a drop in hematocrit level. More specifically, for every 1-unit drop in hematocrit level, the estimated odds of fever increased 2- to 3-fold. Much like Shaw and Chung,² the authors discouraged physicians from basing a decision to initiate a "fever workup" on elevated temperature alone.

The etiology of postoperative fever is multifactorial. In some cases, postoperative fever is considered a normal physiologic response. The phenomenon is believed to result from release of endogenous pyrogens by erythrophagocytotic cells.^{8,9,11-14} Ritter and colleagues¹⁰ postulated that postoperative fever after joint replacement procedures was occasionally caused by hepatocellular damage secondary to polymethylmethacrylate toxicity. Other factors commonly attributed to early postoperative fever include atelectasis and UTI. Interestingly, data supporting the association of atelectasis and fever are lacking.¹⁵ Regarding UTI, Shaw and Chung² found that mean maximum temperature was lower in 11 patients with a positive urine culture (37.6°C) than in patients with a negative urine culture (37.8°C), although this did not reach statistical significance ($P=0.28$). Furthermore, urine cultures were more likely to be positive on postoperative days 4 and 5, by which time temperature had normalized.

We were surprised to find that, compared with the medical service, the orthopedic service was responsible for ordering more blood cultures. This was true even when the residents and physician's assistant were

excluded. We erroneously assumed that members of the orthopedic service would have a better understanding of fever after TJA. However, this might simply be a reflection of their fear of missing an event that could ultimately lead to a prosthetic infection—an instance of fear superseding intuition and knowledge. It is difficult to comment on current practices outside the time frame of this research, but the entrenched behavior of ordering blood cultures for a febrile episode is difficult to change, and that, coupled with fear of missing a true bloodstream infection, might imply that the status quo has not changed. Further research is needed to investigate whether current practices have changed.

To our knowledge, this study represents the largest effort in the orthopedic literature on use of blood cultures to evaluate fever after TJA. Although this study is retrospective, the data are compelling. We conclude that blood cultures are not clinically useful or cost-effective for evaluating fever during the first 2 days after TJA, especially when no clinical signs of sepsis, bacteremia, or remote-site infection are present. Furthermore, we agree with other investigators that thorough history taking and physical examination are needed before initiating a bloodstream infection workup.

Given our study results and the data reported by other investigators, we recommend that blood cultures not be ordered solely on the basis of postoperative fever. A thorough history should be taken, a physical examination should be conducted, and the decision to order blood cultures should be based on the physician's assessment of the patient's entire clinical picture. Because caring for TJA patients requires a multidisciplinary approach, we believe our study results will be helpful to a variety of health care providers.

AUTHORS' DISCLOSURE STATEMENT AND ACKNOWLEDGMENTS

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This paper will be judged for the Resident Writer's Award.
