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Infection Associated With Hematoma Formation After Shoulder Arthroplasty

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Abstract Hematoma formation requiring operative treatment after shoulder arthroplasty may be associated with higher patient morbidity. We therefore determined whether there was an association of hematoma formation requiring operative treatment with deep infection after shoulder arthroplasty. Between 1978 and 2006, we performed 4147 shoulder arthroplasties in 3643 patients. Of these, 12 shoulders (0.3%) underwent reoperation for hematoma formation. The mean time interval from arthroplasty to surgery for the hematoma was 7 days (range, 0.5–31 days). Among nine cases in which cultures were taken, six had positive cultures; the organisms included Propionibacterium acnes in three, Staphylococcus epidermidis in one, Streptococcus species in one, and Staphylococcus epidermidis with Peptostreptococcus in one. The minimum followup was 12 months (mean, 68 months; range, 12 to 294 months). Two of the 12 patients eventually underwent resection arthroplasty for deep infection. The Neer score was excellent in one, satisfactory in six, and unsatisfactory in five patients. The data suggest hematoma formation after shoulder arthroplasty is often accompanied by positive intraoperative cultures. The surgeon should be aware of the high rate of unsatisfactory results associated with this complication as well as the possibility of developing a deep infection requiring additional surgery.
Level of Evidence: Level IV, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Postoperative hematoma formation is a well-known complication after hip and knee arthroplasty [1, 2, 8, 9] and in one study was associated with superficial and deep infection [8]. Large hematomas that cause persistent drainage are rare after total joint arthroplasty but may require a return to the operating room for evacuation, irrigation, débridement, and wound closure. The importance of hematoma formation after shoulder arthroplasty has not been previously described. Furthermore, there is little information in the literature about the sequelae of acute postoperative hematoma formation when patients are returned to the operating room for further surgery.

We asked the following questions: Is there is association of hematoma formation requiring operative treatment and deep infection after shoulder arthroplasty? What are the culture results? What are the radiographic findings? What are the clinical results of shoulder function? What are patient characteristics that predispose one to development of this complication?

Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.
Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Materials and Methods

We retrospectively identified 3541 primary shoulder arthroplasties (3103 patients) and 606 revision shoulder arthroplasties (540 patients) between January 1978 and February 2006. We used the Total Joint Registry at our institution to identify patients who had a return to the operating room for surgical treatment of hematoma formation after shoulder arthroplasty. Of these, 12 patients (12 shoulders: 11 primary arthroplasties and one revision arthroplasty) underwent reoperation for hematoma formation. Indications for reoperating for hematoma included persistent drainage greater than 5 days or the appearance of a tense hematoma underneath the wound. This clinical decision was made by the surgeon. We reviewed the charts of these 12 patients. There were seven males and five females. The average age was 63 years (range, 28–81 years). There were eight cases of hemiarthroplasty and four cases of total shoulder arthroplasty. The indication for the index shoulder arthroplasty was osteoarthritis in four, rotator cuff arthropathy in three, rheumatoid arthritis in two, acute fracture in one, nonunion in one, and neoplasm in one. The mean time interval from the index arthroplasty to surgical treatment of the hematoma was 7 days (range, 0.5–31 days). The minimum followup was 12 months (mean, 68 months; range, 12 to 294 months). We obtained Institutional Review Board approval from our institution. All patients gave consent for their medical records to be reviewed before proceeding with this study.

The hospital charts were scrutinized for potential conditions predisposing for development of hematoma such as history of a bleeding disorder or preoperative anticoagulation therapy. One patient had coagulopathy of unknown etiology and no other patients had risk factors for hematoma formation. Every patient received perioperative intravenous antibiotic prophylaxis (typically, Cefazolin is administered, 1 gram per 70 kg bodyweight within one hour of surgical incision, and every 8 hours for the first 24 hours) at the time of index arthroplasty; this dose is repeated again at the time of repeat surgery for evacuation of the hematoma.

The deltopectoral approach was used at the time of index arthroplasty in all cases. A drain was used during index arthroplasty and placed deep to the deltopectoral interval in eight cases. The drain is discontinued on the first postoperative day. In four cases, a drain was not used. The extent of surgical débridement for hematoma was documented as superficial or deep in relation to the level of the deltopectoral interval. There were seven cases of deep and five cases of superficial débridement. In one case, the upper 60% of the subscapularis repair was disrupted, and revision of repair was performed at the time of débridement.

Of the eight hemiarthroplasties, there were two cemented and six uncemented humeral prostheses. Of the five total shoulder arthroplasties, all humeral stems were uncemented, and all glenoid components were cemented all-polyethylene.

Throughout the time of the study we (RHC, JWS) recorded clinical assessments of all patients with shoulder arthroplasty on a standard shoulder analysis sheet preoperatively and at each followup visit. Patients who were unable to return for followup visits were contacted by our Total Joint Registry to answer our validated shoulder questionnaire, which records pain, function, activities of daily living, range of motion, and patient satisfaction [10]. Of the 12 patients, nine were seen by us (RHC, JWS) in followup and three were contacted by telephone. Pain was graded by the patients preoperatively and postoperatively on a scale ranging from one to five as previously published by Neer et al. [5] and Cofield [3] in which no pain is graded as one point, slight pain as two points, pain after unusual activities as three points, moderate pain as four points, and severe pain as five points. Range of motion in active forward elevation and external rotation were recorded in degrees, and internal rotation was graded by the posterior spinal segment that the patient could reach with the thumb.

Patient satisfaction was recorded based on a scale ranging from one to four [10]. Patients rated their satisfaction as one point if they felt much better, two points if they felt better, three points if they felt the same, and four points if they felt worse. These measurements were obtained by either one of the senior authors (RHC, JWS).

The Neer rating system [5] was used to grade the functional result after revision arthroplasty. To be considered as having an excellent result, patients had to have no or slight pain, had to be satisfied with their results, had to have at least 140° of active forward elevation, and at least 45° of external rotation. A satisfactory result was given if they had no, slight, or moderate pain only with vigorous activities, were satisfied with their result, had at least 90° of active elevation, and at least 20° of external rotation. If these criteria were not met, the patient was considered to have an unsatisfactory result. Patients who later underwent revision surgery were also considered to have an unsatisfactory result.

We analyzed the preoperative, postoperative, and most recent radiographs of the shoulder. Complete sets of radiographs were available for 11 of the 12 patients, including immediate postoperative radiographs from the index arthroplasty and most recent postoperative radiographs. The views included 40° posterior oblique views in internal and external rotation and an axillary view. Radiographs were evaluated by orthopaedic surgeons (EVC, JWS) who were blinded to the identity of the patient and the clinical results. Subluxation of the glenohumeral

joint was considered normal or none, superior, inferior, anterior, or posterior, and direction was graded as mild, moderate, or severe [12]. We considered periprosthetic glenoid lucency mild if there was a 1-mm incomplete radiolucent line, moderate if there was a 1.5-mm incomplete radiolucent line, and severe if there was a 2-mm complete radiolucent line surrounding the prosthesis. Periprosthetic humeral lucency was documented similarly as well as humeral component shift.

The mean preoperative range of motion prior to index arthroplasty was active forward elevation 45° (range, 10°–90°), external rotation 11° (range, 0°–45°), and internal rotation to the sacrum (range, from the abdomen to L5). The mean preoperative pain rating was 4.5 (range, 4–5).

Results

We found an association between hematoma formation undergoing operative treatment with subsequent deep infection after shoulder arthroplasty. Among nine patients in whom cultures were taken, six had positive cultures. We identified the following organisms: Propionibacterium acnes (P. acnes) in three; Staphylococcus epidermidis (S. epidermidis) in one; Streptococcus species in one; and S. epidermidis with Peptostreptococcus in one. Two of the 12 patients eventually underwent resection arthroplasty for deep infection. Five of the six patients with positive cultures had a drain placed at the time of index arthroplasty. Of the two patients who required resection arthroplasty, one had a drain placed at the time of index arthroplasty.

The functional results demonstrate an improvement in motion and self-assessed subjective pain relief and satisfaction. The mean postoperative range of motion was active forward elevation 87° (range, 0°–130°), external rotation 35° (range, 0°–60°), and internal rotation to L5 (range, from the abdomen to L1). The mean postoperative pain rating was 2 (range, 1–3). The mean postoperative satisfaction rating was 2 (range, 1–4).

The Neer score [5] was excellent in one, satisfactory in six, and unsatisfactory in five cases. The reason for an unsatisfactory result was the result of resection arthroplasty for deep infection in two cases and lack of motion in three cases.

Radiolucent lines may be associated with infection or loosening after joint replacement arthroplasty. Of the six patients who had positive cultures, there was one patient with a 1.5 mm incomplete radiolucent line present around a cemented hemiarthroplasty, which eventually required resection arthroplasty for deep infection. In the remainder of the patients, there were no radiolucent lines present around the humeral or glenoid components (when present) to indicate loosening or infection.

The first patient who underwent resection was a 41-year-old man who had osteoarthritis of the shoulder. He was treated at the time of index arthroplasty with primary uncemented hemiarthroplasty. On postoperative day four, he was taken to the operating room for surgical treatment of hematoma formation. Cultures taken at the time of débridement were positive for P. acnes. Nine months postoperatively, he underwent resection arthroplasty for continued pain and suspected deep infection. Intraoperative cultures taken at the time of resection were positive for P. acnes.

The second patient was a 42-year-old woman who had chondrosarcoma of the proximal humerus treated without radiation or chemotherapy, resection of the lesion, and placement of a cemented hemiarthroplasty. Fourteen days postoperatively, she was taken to the operating room for surgical treatment of hematoma formation. Intraoperative cultures taken were positive for S. epidermidis and Peptostreptococcus. Twenty-two months postoperatively, she underwent resection arthroplasty for a painful, loose prosthesis and suspected deep infection. Intraoperative cultures taken at the time of resection were positive for S. epidermidis and Peptostreptococcus.

Discussion

Postoperative hematoma formation is a well-known complication after hip and knee arthroplasty [1, 2, 8, 9] and in one study has been associated with superficial and deep infection [8]. Hematoma formation for patients undergoing subsequent operative drainage and débridement after shoulder arthroplasty may be associated with higher patient morbidity but there is little literature on the subject. We therefore determined whether there was an association of hematoma formation in patients undergoing operative drainage and débridement with deep infection after shoulder arthroplasty.

Limitations of this study include its retrospective nature and the small number of patients in this series. In our study, two patients had rheumatoid arthritis, one patient had chondrosarcoma, and one patient had a coagulopathy. However, because of the small number of patients in our series, we are unable to determine a difference in outcome comparing these patients with those without risk factors for infection. In addition, the decision whether to reoperate for hematoma formation based on the surgeon's discretion. The decision whether to take intraoperative cultures was also surgeon-dependent.

Our limited data demonstrate hematoma formation in patients undergoing operative débridement after shoulder arthroplasty is associated with positive culture results. This may ultimately manifest as deep periprosthetic infection.

Efforts should be made at the time of surgery to obtain meticulous hemostasis to prevent hematoma formation.

One study suggests deep wound infection after total knee and hip arthroplasty correlates with superficial surgical site infection [8]. Saleh et al. [8] reported 19 out of the 33 (58%) study subjects with superficial surgical site infection developed deep wound infection. Of the preoperative, intraoperative, and postoperative factors examined, only hematoma formation and days of postoperative drainage were noteworthy predictors of superficial surgical site infection. The authors concluded hematoma formation and persistent postoperative drainage increase the risk of superficial and subsequent deep infection. The cases consumed more health care resources at all stages of the medical process. Postoperative monitoring of patients for hematoma and persistent drainage enables earlier intervention that may lower the risk of developing deep infection.

The clinical efficacy of the use of a drain after shoulder arthroplasty and its association with positive culture results is not known. We commonly use a postoperative drain but routinely remove it on postoperative day number one. In a meta-analysis of 5697 major orthopedic procedures, Parker et al. [6, 7] showed no difference in rates of infection, hematoma formation, or reoperations for wound complications with the use of a postoperative drain. In a prospective cohort study, Sorensen et al. [11] evaluated drain tips in 489 orthopedic procedures including hip and knee arthroplasties and hip fractures. They reported positive cultures in 11% of drain tips. However, only 1% (five patients) were infected by the same bacteria as had grown on the culture tip specimen.

Infection after shoulder arthroplasty has been associated with rheumatoid arthritis, diabetes mellitus, advanced age, remote sites of infection, malnutrition, and immunosuppressive chemotherapy [15]. Infection after hip and knee arthroplasty has been associated with diabetes mellitus and chronic disease [4]. The successful management of a patient with an infected shoulder arthroplasty is a challenging problem. Our data suggest clinical improvement in range of motion, pain relief, and patient satisfaction in the majority of patients, but the clinical results in this subset of patients are inferior to those who have shoulder arthroplasty for osteoarthritis [12].

Sperling et al. [13] reported the deep infection rate for primary shoulder arthroplasty at this institution was 0.8% (19 of 2279 shoulders) and for revision arthroplasty it was 3% (seven of 194 shoulders). In comparison, the rate of positive cultures indicating infection in those shoulders with hematoma formation in this study was relatively high. Six of the nine patients who had cultures taken had positive cultures. The data from our study suggest hematoma formation after shoulder arthroplasty is often accompanied by positive intraoperative cultures.

Topolski et al. [14] reported on 75 shoulders which had positive intraoperative cultures during routine revision shoulder arthroplasty in patients without clinical evidence of overt infection. At the authors' institution, the rate of positive cultures during routine revision shoulder arthroplasty was 17% (75 of 439 shoulders). The most common pathogen cultured was P. acnes. Another operation was necessary in 13% of patients at a mean of 2.5 years to decrease pain or improve function. Preoperative C-reactive protein, erythrocyte sedimentation rate, and intraoperative histologic evaluations were negative in 75%, 86%, and 92%, respectively. The authors concluded there are no good preoperative or intraoperative investigations to detect who will have a positive intraoperative culture at the time of revision shoulder arthroplasty.

The surgeon should be aware of the high rate of unsatisfactory results associated with postoperative hematoma formation requiring operative treatment and the possibility of developing a deep infection requiring additional surgery.

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