Postoperative Death Associated With a Reverse Prosthesis

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Abstract

The mortality rate after total shoulder arthroplasty, and specifically after reverse total shoulder arthroplasty, has not received much attention in the literature. Although complications of the reverse total shoulder arthroplasty are well known, fatalities secondary to complications related to the unique features of the reverse prosthesis have not, to our knowledge, been previously reported.

We report the case of an elderly man who developed shoulder instability after the implantation of a reverse prosthesis followed by disassociation of the glenosphere from the baseplate. After a reoperation to revise and reassemble the components, he developed an infected shoulder and sepsis, and subsequently died from the complications of sepsis.

This death represents a perioperative mortality rate of 0.5% in our series of 190 cases. The mortality rate after reverse total shoulder seems to be similar to that after standard total shoulder arthroplasty.

Grammont and colleagues[1] have been credited with the design, in 1985, of the reverse total shoulder prosthesis for patients with cuff tear arthropathy. Since that time, the reverse prosthesis has undergone many design changes, and the indications have expanded to include a wider range of shoulder abnormalities.[2] The reverse total shoulder gained popularity in the 1990s and was released for use in the United States in 2004.[3]

Although there are many clinical studies that substantiate relief of pain and increased function in patients who undergo a reverse prosthesis, other studies caution about the widespread use of this type of shoulder replacement.[4] The complication rate of reverse prosthesis has been reported to be from 0% to 68%.[4] Most of those studies concentrate on the intraoperative and postoperative complications related to the prosthesis insertion.

Mortality after reverse prosthesis has not been frequently reported.[5] However, to our knowledge, no study has mentioned mortality directly related to complications from a reverse prosthesis surgical procedure. Our goals were to review the literature on mortality after reverse prosthesis, to report a fatality that resulted directly from complications secondary to implantation of a reverse prosthesis, and to describe the mortality rate in our patient population that underwent reverse prosthesis.

The patient's next of kin provided written informed consent for print and electronic publication of this case report.

Case Report

An 85-year-old, right-dominant man presented to our office with severe pain and limitation in both shoulders, but mainly in his right shoulder. He was particularly concerned because his right shoulder pain and loss of function were preventing him from finishing the renovations on his house. He reported that he had injured his shoulder 10 years previously, but that the subsequent pain and loss of motion had occurred slowly over time. He had pain at rest, at night, and after use of his extremity that was unrelieved by nonsteroidal medication, analgesics, or cortisone shots. He was in good health otherwise, except for hypertension that was well controlled by medication.

On examination, he had atrophy of his supraspinatus and infraspinatus muscles bilaterally, was weak in abduction and external rotation to strength testing in both shoulders, had a positive external rotation lag sign for his right shoulder, and had pain and crepitus with any right shoulder motion. On his right side, his active and passive elevations were 90° and 150°, respectively, and his external rotation at 90° of elevation was 15°. He was neurovascularly intact for all sensation and motor testing of all peripheral nerves, myotomes, and dermatomes.

His radiographs showed a cuff tear arthropathy with severe arthritic changes of the glenohumeral joint. Because nonoperative treatment had failed, we discussed with the patient and his family the risks, benefits, and potential complications of the reverse prosthesis. The patient elected surgery and had medical clearance by his internal medicine physician and by our institution's anesthesia department.

He underwent an uneventful implantation of a Delta-type

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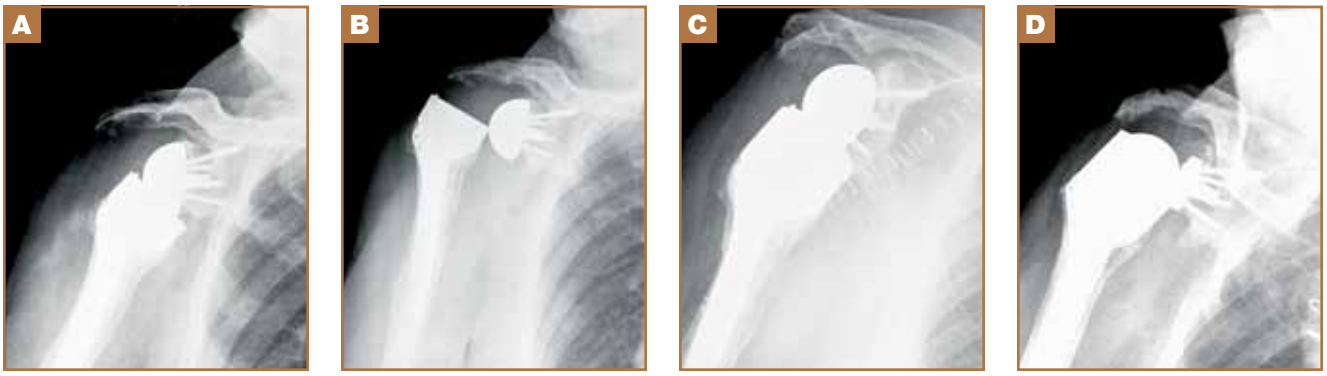

Figure. (A) A postoperative anteroposterior (AP) radiograph with the shoulder reduced. (B) An AP radiograph of the patient's shoulder with a dislocation of the reverse prosthesis. (C) An AP radiograph of the patient's shoulder shows humeral metaphyseal inserts to lengthen the humerus. (D) An AP radiograph of a dislocated reverse prosthesis with glenoid sphere disassociated from the glenoid baseplate.

reverse total shoulder prosthesis. He had no rotator cuff attachment to the proximal humerus, but a biceps tenodesis was performed. Stability of the reverse construct was tested while the patient was on the table, and he had no arm positions that resulted in impingement or instability.

After surgery, he was placed in a shoulder immobilizer but allowed range of motion of his fingers, wrist, and elbow on the first postoperative day. He was allowed to bend over to wash his axilla, but pendulum exercises were not started. He was seen 10 days after surgery in the clinic and found to be pain-free and neurologically intact. Radiographs at that time showed a well-positioned reverse prosthesis (**Figure, A**). He was instructed to wear the brace only at night and told not to do pendulum exercises until his next office visit in 4 weeks. At that visit, the patient's examination and radiographs were unchanged.

Eight weeks after surgery, the patient was re-evaluated, at which time he reported some numbness and weakness in his hand. An electromyography and nerve conduction study revealed an incomplete lower cord plexopathy. He had excellent strength in abduction and had no signs of deltoid dysfunction.

Ten weeks after surgery, the patient returned for another re-evaluation and reported weakness in abduction of the arm; he reported no trauma. Radiographs revealed a dislocated reverse prosthesis with the humerus anterior and superior to the glenoid sphere (**Figure, B**).

The next week, he was returned to the operating room, general anesthesia administered, and a closed reduction performed under fluoroscopic guidance. Under anesthesia, his shoulder was stable, except in arm extension and external rotation with the arm in an adducted position. After surgery, he was placed in a shoulder immobilizer with his arm at his side and in internal rotation. He was particularly told not to reach behind his back or externally rotate his shoulder when his arm was at the side.

On his re-evaluation 10 days later, the patient had no pain but still reported arm weakness. Radiographs revealed not only a dislocation of his shoulder, but also that the glenoid sphere had disassociated from the glenoid baseplate (**Figure, C**). On discussion with the patient and the family, it was decided to reoperate on his shoulder to replace the sphere in its correct position and to reduce the shoulder. At the time of surgery, the glenoid sphere was replaced and the polyethylene insert was increased by 1 cm to increase the stability of the construct (**Figure, D**). There were no signs of infection with any exudates; cultures were not taken at the time of surgery. The patient did well after surgery and was discharged after 3 days.

Six days after surgery, the patient returned with a nonpurulent bloody discharge from his wound. He was afebrile and his white blood cell count was normal. Radiographs showed a well-positioned reverse shoulder. The next day, the patient underwent surgical debridement and a large amount of sanguineous fluid from a deep hematoma was evacuated. The wound was debrided and closed over drains. Subsequent cultures grew a coagulase-negative *Staphylococcus* organism and, with the advice of infectious disease specialists, intravenous vancomycin was started. After sensitivities were obtained, intravenous oxacillin and oral rifampin were administered. Five days after starting this antibiotic regimen, his serum creatinine rose to 4.5 mg/dL and he had an acute attack of gout. As a result, he was switched back to intravenous vancomycin and eventually discharged 23 days after his surgery. He had a follow-up every 10 days in the office; there was no change in his clinical picture and his prosthesis remained stable with normal radiographs.

Five weeks after discharge from the hospital, the patient was admitted to a different nearby hospital with fevers and chills. His right shoulder was swollen, and aspiration found purulent material. He was urgently transferred to our facility, where it was noted that his shoulder was markedly swollen and the patient appeared pale and diaphoretic. Although his vital signs were stable, he had increasing pain and there were concerns that he might become systemically septic.

The next day, the patient underwent an incision and drainage, at which time a substantial volume of purulent material (500 mL) was removed from his shoulder. Exchange of

Table. **Deaths After Shoulder Arthroplasty**

Study	N	Deceased patients (n)	Time of death	Initial complication	Underlying disease
Reverse Total Shoulder					
Favard and colleagues[8]	428	1	N/A	infection and chronic fistula	N/A
Jacquot and colleagues[9]	457	1	7 minutes after surgery	deep infection with a persistent fistula	N/A
Jouve and colleagues[10]	65	4	during the postoperative period	N/A	N/A
Molé and colleagues[11]	47	1	few months after surgery	dislocation (emergency operation)	massive cuff tear
Sirveaux and colleagues[13]	457	1	4 weeks after surgery	dislocation, glenoid loosening, and infection	extensive metastasis of the humerus
Walch and colleagues[14]	203	1	N/A	N/A	proximal humeral fractures
Total Shoulder Arthroplasty					
Jain and colleagues[6]	N/A	0.20% to 0.36%	N/A	N/A	N/A
Rockwood and colleagues[12]	1	1	1 day after surgery	pulmonary embolism	N/A

Abbreviation: N/A, information not available.

the components was not performed at that time because it was thought that his medical condition prohibited the large procedure involved in removing the well-cemented humeral component and well-fixed glenoid component. The patient's shoulder was thoroughly debrided and lavaged, and the wound was closed over drains. Cultures subsequently grew methicillin-resistant *Staphylococcus* and vancomycin was restarted. Suppressive antibiotics were deemed the best treatment option in light of his increasingly tenuous medical condition and this decision was discussed at length with the family because there was concern about his ability to survive additional surgery.

After surgery, the patient developed atrial fibrillation, which was evaluated by our cardiology service and he received low-molecular-weight heparin as an anticoagulant. Despite medical treatment, his gout worsened to the point that he was unable to ambulate. The patient had a peripherally inserted central catheter line placed in his contralateral arm and was started on suppressive antibiotics (clindamycin). During his hospitalization, the patient's shoulder showed no clinical signs of reaccumulation of fluid and he was discharged to a rehabilitation facility. He was at that facility less than 1 week when he developed diarrhea, which was cultured and due to a vancomycin-resistant *Enterococcus* infection. He became septic and blood cultures grew methicillin-resistant *Staphylococcus*. He became confused despite medical treatment and was readmitted to our facility. The peripherally inserted central catheter line was removed and cultured, and re-aspiration of his shoulder under fluoroscopy showed clear synovial fluid. Subsequent cultures of this shoulder aspirate were negative.

Despite these findings, the patient became increasingly confused and sustained respiratory arrest. He was intubated and transferred to the intensive care unit, where his blood pressure was maintained by several different intravenous pressor agents. He became increasingly obtunded and unresponsive, and 3 days later sustained a cardiac arrest. Attempts at resuscitation were unsuccessful and he died 8 months after his original surgery. This patient's death represents the only fatality (0.5%) among the 190 patients for whom we performed a reverse prosthesis procedure from July 2007 through October 2011.

Discussion

To our knowledge, there are no studies that report a death within 2 months of a reverse prosthesis procedure nor a death secondary specifically to complications of the reverse prosthesis that required reoperation. The mortality rate reported for total shoulder arthroplasty in the literature ranges from 0.25% to 0.58%.[6,7] Because our rate is based on a retrospective review, it is possible that fatalities occurred of which we were unaware. However, we believe this case report is the first to specifically document a fatality directly attributable to surgery made necessary because of a complication unique to a reverse prosthesis (ie, disassociation of the sphere from the baseplate). Although the patient's infection was secondary to the reoperation, it can be suggested that this sequence of events would not have occurred if the patient had not required reoperation for this complication. Although the subsequent infection and systemic collapse could occur with any joint prosthesis, this case is a reminder that the consequences of complications of reverse total shoulder surgery can be fatal.

Fatalities after total shoulder arthroplasty and reverse total shoulder surgery are uncommon (**Table**).[6,8-14] A 7-year study by Hammond and colleagues[15] found no in-hospital fatalities in Maryland secondary to shoulder replacement surgery for osteoarthritis. During that same time period, there were 54 (0.16%) deaths in the immediate postoperative period after total knee arthroplasty and 27 (0.18%) after total hip arthroplasty.[16] At least 1 other study supports the observation that mortality after total shoulder arthroplasty is uncommon.[7] The 90-day mortality rate after total shoulder arthroplasty in 1 study was found to be 0.58% (17 of 2953),[7] and another study evaluating shoulder arthroplasty outcomes from 1998 to 2000 reported a mortality rate of 0.25% (32 of 12,594).[6] The results of our study may be difficult to compare with these results because our population included only 190 patients.

Instability represents the most common complication after a reverse total shoulder surgery; its reported frequency ranges from 0% to 30%.[17,18] The initial treatment for instability of a reverse prosthesis is to perform a closed reduction. At the time of reduction, the stability of the implant should be determined, but typically a trial of immobilization, as used in this case, is recommended before any surgical interventions are attempted. If the instability continues despite nonoperative treatment, then the options depend on the type of reverse prosthesis that is implanted. In the Delta-type reverse prosthesis, the options are to place more polyethylene inserts or even metal inserts to create more tension on the construct, or to completely revise the humeral and sphere components.

Disassociation of the components of the reverse prosthesis has been described in the literature, but it is an uncommon complication.[4] In a study of 399 reverse shoulders, Molé and colleagues[11] found that incomplete seating of the sphere on the baseplate may occur in up to 16% of components. In our patient, the technical error postulated to have led to the sphere becoming dislodged was that the central screw engaged into the baseplate before the sphere was impacted into the baseplate. The engagement of the screw prevented the sphere from being fully seated onto the baseplate and despite the screw being seated fully later, the sphere was not engaged enough on the baseplate to withstand the forces exerted on the sphere-baseplate interface. Although speculative, it was thought that this procedure may have kept the sphere from seating entirely down on the morse taper, which is the primary mechanism for sphere-baseplate fixation.

Infection after reverse shoulder arthroplasty has been reported with a rate of 1.25% to 15%.[4] Infection rates reportedly are higher in patients undergoing a revision surgery than in those having primary surgery.[19] The treatment options for an infected arthroplasty include suppressive antibiotics, incision and drainage with or without exchange of polyethylene or sphere components, excisional arthroplasty, 1-stage exchange, or 2-stage exchange. In our patient, the decision was to proceed with incision, drainage, and suppressive antibiotics for 3 reasons: 1) the patient was becoming increasingly weak from multiple surgical procedures, and we were concerned that his condition precluded the removal of a well-cemented stem; 2) the infection was thought to be an acute infection, which has often been shown to be reversible with debridement and antibiotics alone[20]; and 3) the first infection was with an organism of low virulence that was sensitive to less toxic antibiotics. It is possible that earlier removal of the patient's components might have resulted in a more rapid recovery, but re-aspiration of his shoulder after he became hypotensive suggested that the infection in his shoulder had cleared.

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Although this patient's death was primarily the result of a nosocomial infection, the shoulder infection that required treatment was the result of reoperation for a disassociation of his reverse prosthesis implants. The reverse prosthesis presents many challenges to the surgeon and patient, and, as with any joint arthroplasty, the risks, benefits, and potential complications should be discussed thoroughly with patients considering this procedure. However, additional study is warranted to determine the exact mortality after reverse total shoulder arthroplasty.

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