Revision Total Hip Arthroplasty in Jehovah's Witnesses

Steven F. Harwin, MD; Robert Pivec, MD; Aaron J. Johnson, MD; Qais Naziri, MD; Michael A. Mont, MD

abstract

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Revision total hip arthroplasty (THA) is associated with greater blood loss than primary THA. Jehovah's Witnesses will not accept transfusions of blood or blood products and are thus at an increased risk for complications due to perioperative anemia. The purpose of this study was to report the clinical outcomes, radiographic outcomes, morbidity, and mortality of Jehovah's Witnesses who were medically optimized and underwent revision THA.

Databases from 2 institutions were reviewed to identify 10 patients (11 THAs) who were Jehovah's Witnesses undergoing revision THA with a minimum 24-month follow-up. At most recent follow-up, all patients were doing well clinically, with Harris Hip Scores greater than 80 points. Radiographic evaluation demonstrated well-positioned components and no progressive radioluciencies. No major perioperative medical or surgical complications occurred in patients undergoing THA. Revision THA for aseptic causes results in good clinical outcomes in patients who are preoperatively optimized before undergoing surgery.

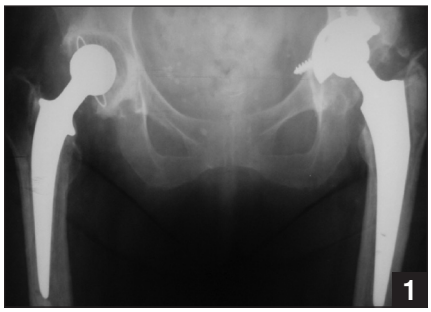

Figure 1: Preoperative anteroposterior radiograph of the pelvis with bilateral infected total hip arthroplasty.

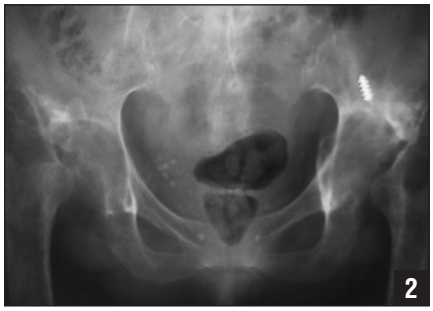

Figure 2: Anteroposterior radiograph of the pelvis showing interval removal of left and right prosthetic components.

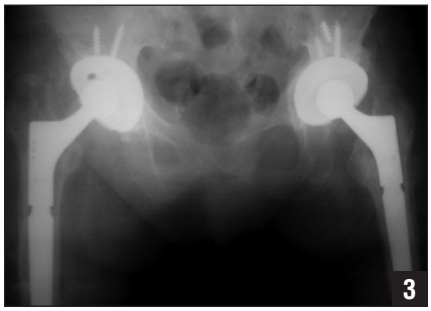

Figure 3: Anteroposterior radiograph of the pelvis demonstrating bilateral component reimplantation following successful infection eradication.

Dr Harwin is from the Adult Reconstructive Service, Total Joint Replacement Bloodless Surgery Program, Beth Israel Medical Center, New York, New York; and Drs Pivec, Johnson, Naziri, and Mont are from the Rubin Institute for Advanced Orthopedics, Center for Joint Preservation and Replacement, Sinai Hospital of Baltimore, Baltimore, Maryland.

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Correspondence should be addressed to: Michael A. Mont, MD, Rubin Institute for Advanced Orthopedics, Center for Joint Preservation and Replacement, Sinai Hospital of Baltimore, 2401 W Belvedere Ave, Baltimore, MD 21215 (mmont@lifebridgehealth.org).

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Up to 10% of patients undergoing primary total hip arthroplasty (THA) will require a revision at some point in the future.[1] In addition, the revision burden is projected to increase 137% in the coming 2 decades.[2-4] Physicians will continue to care for patients who may differ from the general population's demographics by virtue of medical circumstance or because of personal or religious choice. Whereas Christian Scientists by and large reject all conventional medical intervention, Jehovah's Witnesses are receptive to medical care in general but oppose transfusions of whole blood or blood components (red blood cells, white blood cells, platelets, and plasma).

In the approximately 7 decades since the adoption of this doctrine, published case reports regarding surgical outcomes and blood management strategies in the medical literature have spanned nearly every intervening decade.[5-13] However, few reports have been published regarding revision THA in this subset of patients, and even fewer have systematically and objectively measured postoperative clinical outcomes. Because of the risks associated with perioperative blood loss resulting in postoperative anemia, physicians must be able to counsel their patients on expected outcomes using evidence-based data. However, many surgeons continue to be apprehensive regarding operating on patients who refuse blood transfusions for many procedures, including fractures, tumors, trauma, and elective primary and revision joint arthroplasty.

Revision THA is associated with a greater risk of perioperative blood loss than for primary THA. In the general population, mortality is uncommon, but marked blood loss is associated with increased blood transfusions, length of stay, morbidity, and mortality.[14-16] Intraoperative blood loss may be 2000 mL or more, requiring 6 units or more of autologous or allogeneic blood to correct.[17,18] With reported transfusion rates of 45% during revision surgery, this treatment option is not available to physicians caring for patients who are Jehovah's Witnesses.[19,20] Therefore, the risk associated with transfusion-free surgery has led to the development of bloodless surgery programs throughout many of the surgical subspecialties.[21]

Although initially directed toward Jehovah's Witnesses, with increased awareness of the risks involved with blood transfusions, many who have no religious convictions proscribing administration of blood are now seeking bloodless surgery options. Strategies include preoperative hemoglobin optimization, intraoperative minimization of blood loss by surgeons with the cooperation of specialized anesthesiologists, shorter surgical times, and postoperative care that minimizes blood loss and supports hematopoiesis.[7,11,21-28] Pharmacologic approaches include treatment with erythropoietin, iron, and folate. Randomized trials have demonstrated a reduction in the risk of transfusion in patients treated with erythropoietin, including those who were critically ill.[29-31] Several studies have established a once-weekly dosing schedule of 40,000 IU (300-600 IU/kg) to be effective, and synergism has been observed in patients treated in combination with iron (325 mg of ferrous sulfate 3 times a day).[21,32] Patients with hemoglobin values between 10 and 14 g/dL are most likely to benefit. Intraoperatively, antifibrinolytics such as tranexamic acid (10 mg/kg) given as a single dose preoperatively has been shown to decrease blood loss and the transfusion rate.[33] Hypotensive anesthesia also effectively decreases blood loss without impairing renal function but is technically demanding.[34-36] Postoperatively, reinfusion drains may reduce the need for transfusions in THA and total knee arthroplasty but cannot be used in cases of infection or malignancy.[37,38]

With no option to transfuse, surgeons may speed up surgery or make intraoperative procedural changes to avoid prolonged blood loss. Therefore, this could result in less than optimal implant position and alignment. Short- and long-term outcomes may also be affected. For experienced surgeons and those familiar with blood salvage and conservation programs, revision surgery is not a contraindication in patients who are Jehovah's Witnesses and must decline blood or blood product transfusions. To the authors' knowledge, no studies have examined clinical outcomes outside of the immediate postoperative period. The purpose of this study was to observe (1) perioperative complications, (2) midterm clinical outcomes, (3) implant survivorship, and (4) radiographic outcomes in Jehovah's Witnesses undergoing revision THA.

Table 1
Patient Data

Variable	Data
Patients, No.	10
Men	3
Women	7
Hips, No.	11
Mean age (range), y	67 (38-80)
Mean BMI (range), kg/m^2	34 (26-45)
Mean follow-up (range), mo	69 (24-120)
Implant survivorship, %	100
Complications, No.	
Medical	1
Surgical	1
Mortality, No.	0

Abbreviation: BMI, body mass index.

Materials and Methods

This multicenter study identified all revision THAs performed in Jehovah's Witnesses between 1998 and 2009 by 2 fellowship-trained surgeons specializing in revision surgery (S.F.H., M.A.M.). Ten patients (11 THAs) who met inclusion criteria were identified (Table 1). Three men and 7 women had a mean age of 67 years (range, 38-80 years) and mean follow-up of 69 months (range, 24-120 months). in-

stitutional review board approval was obtained for this study.

Patients were included if they identified themselves as Jehovah's Witnesses who had previously received a primary THA. Exclusion criteria included patients who did not identify themselves as Jehovah's Witnesses or patients who did not undergo treatment with the comprehensive blood management protocol. One patient who was a Jehovah's Witness was excluded for the latter reason. This patient was referred with massive periprosthetic infection with draining thigh and pelvic abscesses. He presented with sepsis and renal failure. He underwent urgent implant removal without the opportunity to optimize him preoperatively and died secondary to complications related to sepsis and renal failure, not postoperative anemia.

Indications for revision surgery were a loose acetabular and femoral component due to osteolysis in 3 patients, a loose stem in 1 patient, a loose cup in 1 patient, polyethylene wear in 3 patients, and deep infections in 2 patients. The deep infections were treated with 2-stage revision.

The patients were managed perioperatively based on an established blood management protocol (Figure 1). Preoperatively, patients were treated with erythropoietin (600 u/kg weekly for 3 weeks), iron (325 mg daily) and folate (1000 mg daily) to maximize red blood cell mass. Intraoperatively, all patients were placed under hypotensive anesthesia. Emphasis was placed on meticulous hemostasis and decreased surgical time. A closed-circuit Cell Saver device (Haemonetics, Braintree, Massachusetts) was used for all aseptic revisions. Postoperative care included reinfusion drains for all aseptic revisions and standard drains for septic revisions. Venous thromboembolism prophylaxis included mechanical sequential compressive devices and avoidance of pharmacological agents. Patients were mobilized postoperatively based on each institution's physical therapy protocol.

Patients were followed at approximately 6 weeks, 3 and 6 months, 1 year, and annually thereafter. Range of motion and Harris Hip Score were recorded during each office visit. All implants were evaluated radiographically at each visit with anteroposterior and lateral radiographs of the hip. Radiographs were evaluated by identifying any progressive radiolucencies about the femoral or acetabular component, implant subsidence or migration, periprosthetic fracture, or component failure.

Medical and surgical complications were identified. Medical complications included deep venous thrombosis, pulmonary embolism, cardiac arrhythmias, and renal failure. Surgical complications in the perioperative period included hematoma formation, superficial infection, and prolonged wound drainage. Postoperative complications included return to the operating room for polyethylene exchange, deep infection, periprosthetic fracture, and heterotopic ossification excision.

All data were compiled and evaluated using an Excel spreadsheet (Microsoft, Redmond, Washington). No statistical analysis was necessary to evaluate the data.

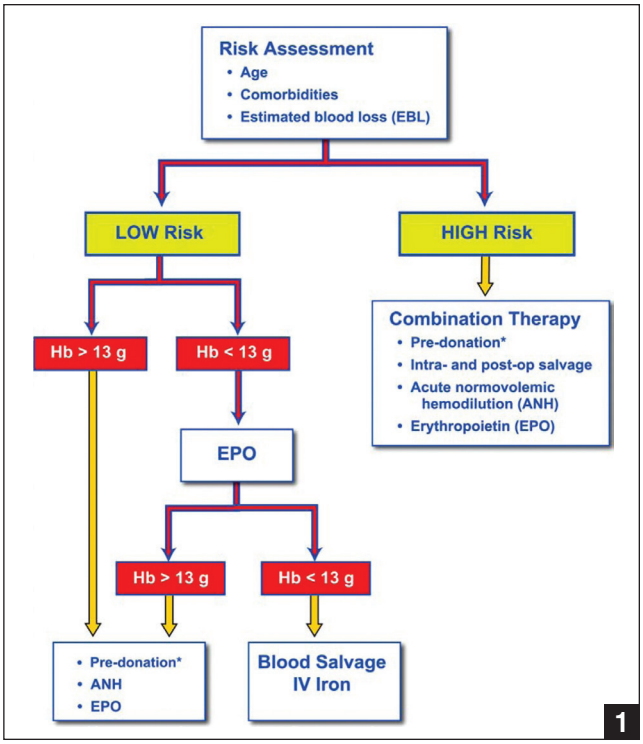

Figure 1: Flow chart of perioperative blood management strategies used for Jehovah's Witness patients. Dosages used: erythropoietin (600 IU/kg intravenously [IV] per week for 21 days) and iron (25-100 mg IV daily), calculated as [dose=0.0442×(desired Hb−observed Hb)×LBW+(0.26×LBW)], where Hb is hemoglobin and LBW is lean body weight. All patients also receive folate (1000 mg orally daily) and iron supplementation (325 mg orally daily). Pharmacologic deep venous thrombosis prophylaxis is avoided. *Predonation is not accepted by Jehovah's Witnesses.

RESULTS

All patients seen at most recent follow-up were doing well clinically, with Harris Hip Scores greater than 80 points, and were all ambulating without assistive devices. No patient was lost to follow-up.

Radiographic evaluation demonstrated no progressive radiolucencies, implant subsidence, or failure of any kind in any patient during the study period. No re-revisions were performed for septic or aseptic causes, including loosening, implant migration, implant failure, or pain. Implant survivorship at midterm follow-up was 100%.

One medical complication, a deep vein thrombosis, occurred in the perioperative period and was treated with oral anticoagulation. Concurrent pulmonary embolism was ruled out with contrast-enhanced computed tomography. One surgical complication, a superficial wound infection, occurred and was treated with local

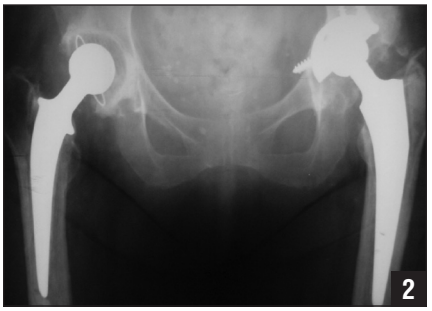

Figure 2: Preoperative anteroposterior radiograph of the pelvis with bilateral infected total hip arthroplasty, which was performed in Guatemala in a staged fashion 3 years prior to referral for infection.

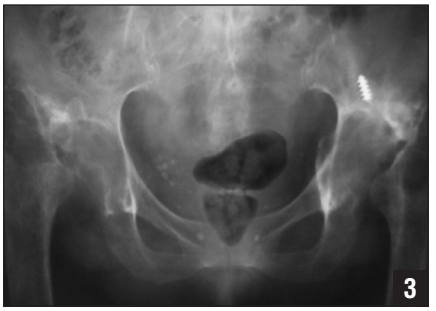

Figure 3: Anteroposterior radiograph of the pelvis showing interval removal of left and right prosthetic components.

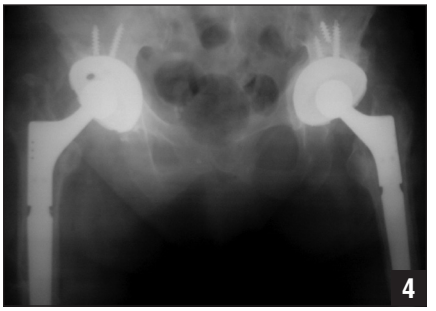

Figure 4: Anteroposterior radiograph of the pelvis demonstrating bilateral component reimplantation following successful infection eradication.

debridement and a course of oral antibiotics. Both patients were doing well at most recent follow-up, with Harris Hip Scores more than 80 points. No mortalities occurred.

Case Reports

Patient 1

In the setting of chronic infection, the standard of care is 2-stage revision THA with placement of an antibiotic spacer and treatment with parenteral antibiotics. The presence of bilateral periprosthetic infection increases the level of difficulty and, in patients who cannot accept blood transfusions, places increased emphasis on careful preoperative planning and medical optimization. The case of a patient with bilateral infected THAs is presented to illustrate the process by which patients who cannot be transfused can be safely and successfully treated with revision surgery.

A 64-year-old woman was referred for treatment of a chronic bilateral periprosthetic infection. The patient had undergone staged bilateral primary THA in Guatemala 3 years prior. The implants used were a cemented Charnley-type prosthesis on the right hip and a proximally porous coated femoral stem with cement and a cementless cup with screws on the left hip (Figure 2).

Two-stage revision THA for both hips was planned, which consisted of 4 separate surgeries over the course of approximately 1 year (3- to 4–month intervals between surgery). The patient was medically optimized prior to each surgical procedure. The first procedure was removal of the left prosthesis, followed by removal of the right prosthesis 3 months later (Figure 3). Approximately 6 months following the index procedure, the patient was infection free based on serological markers and underwent staged reimplantation. A cementless, modular femoral stem and cementless cup with screws were implanted on the left hip. Approximately 3 months later, the patient was medically optimized and cleared for reimplantation of the right hip using the same components as the contralateral side (Figure 4).

At most recent follow-up, the patient was infection free, had returned to her prior activities of daily living, and was able to ambulate without the use of assistive devices. Radiographic assessment demonstrated good component alignment with no evidence of implant subsidence, migration, or failure.

Patient 2

A 73-year-old man presented with right hip pain 12 years after cementless THA. Preoperative radiographs demonstrated massive osteolysis about the acetabular component and lesser trochanter with a soft tissue mass, loosening and migration of the cup, and severe eccentric polyethylene wear (Figure 5). Workup for infection was negative. Following preoperative optimization, successful revision surgery was performed with debridement of several large periarticular granulomas (Figure 6) and acetabular component revision with a cementless cup and a posterior column screw. A new cobalt-chromium head and polyethylene liner were placed with retention of the femoral component, which was well fixed. Lesser trochanter

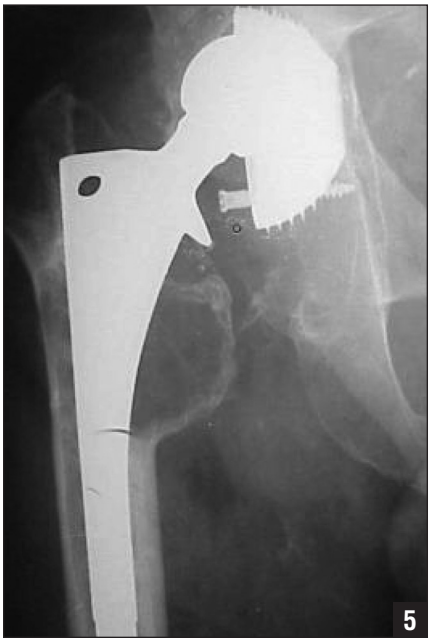

Figure 5: Preoperative anteroposterior radiograph of the right hip demonstrating massive osteolysis, loosening and migration of the acetabular cup, and severe polyethyelene wear.

osteolysis was management by placement of a medial cortical strut graft stabilized with cerclage cables (Figure 7). At most recent follow-up, 6 years postrevision, the patient had no significant pain and a Harris Hip Score of 85 points.

DISCUSSION

The goal of this study was to investigate the perioperative morbidities and midterm clinical outcomes of Jehovah's Witnesses undergoing revision THA as measured by Harris Hip Scores, implant survivorship, radiographic outcomes, morbidity, and mortality. Previous studies have reported favorable outcomes of revision THAs in low-risk patients optimized for surgery. Although the current authors also observed similar outcomes to those reported in the literature following aseptic revisions in healthy, optimized patients, the risks of surgery must be carefully considered.[9,10,12,39] The current authors believe that their comprehensive blood optimization and management program contributed to their excellent outcomes.

The current study was limited in the number of patients available for analysis. Relatively few Jehovah's Witnesses require revision THA, which makes comparisons of morbidity and mortality rates unreliable. Studies with greater power may better elucidate the relationship between mortality and revision surgery in this group, especially in the subgroup of patients with deep infections. Despite these limitations, the current study was able to objectively report clinical outcomes in a sizable number of Jehovah's Witnesses with longer follow-up than has been previously published.

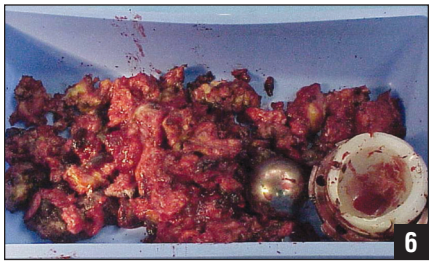

Figure 6: Intraoperative photograph of the excised massive granuloma, removed femoral head, and severely worn acetabular liner.

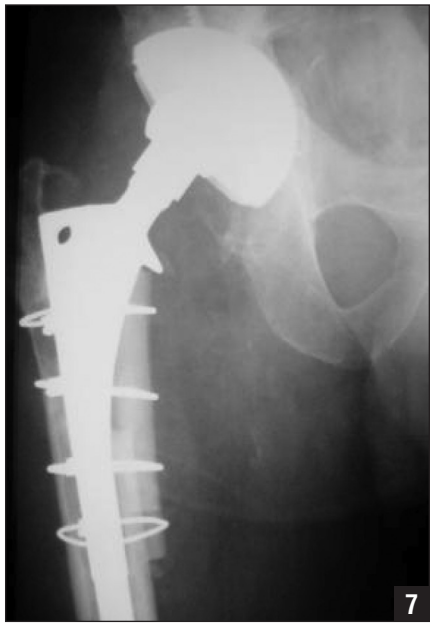

Figure 7: Postoperative anteroposterior radiograph of the right hip showing revision of the loose acetabular cup, exchange of the femoral head and polyethylene liner, retention of the femoral component, and placement of a medial cortical strut graft.

Reports of mortality in Jehovah's Witnesses undergoing orthopedic procedures are rare in the literature,[40,41] with Bonnett et al[39] reporting 1 case of fatal air embolism in 105 primary THAs. Of the 4 published studies or case reports describing revision THA in this patient population, none reported mortalities (Table 2).[11,13,39,41]

In the largest study, Nelson and Bowen[41] reported inpatient results of 100 patients with a mean age of 56 years (range, 13-86 years), including 24 patients undergoing revision THA. No mortalities occurred; however, comorbidities were not specifically mentioned, and all patients underwent extensive cardiac, pulmonary, and renal testing to determine

Table 2

Outcomes of Reported Revision THAs in Jehovah's Witnesses

Study	Patients, No.	Mean Age (Range), y	Mean BMI (Range), kg/m^2	Mean Follow-up (Range), mo	Mortality, %	Notes
Nelson & Bowen[41]	24	56 (13-86)[a]	NR	Inpatient	0	Hypotensive anesthesia used in all patients
Bonnett et al[39]	2	47 (27-68)	NR	Inpatient	0	Hypotensive anesthesia used in all patients
Wittmann & Wittmann[13]	5	NR	NR	Inpatient	0	Mean postoperative hemoglobin, 7.2 g/dL
Sparling et al[11]	5	66 (58-78)	NR	Inpatient	0	Preoperative erythropoietin (100 IU/kg 3 times/wk for 3 wk)
Current study	10	68 (38-80)	34 (26-45)	69 (24-120)	0	Preoperative eyrthropoietin, iron, folate. Hypotensive anesthesia. Cell saver for aseptic revisions.

Abbreviation: BMI, body mass index; NR, not reported; THA, total hip arthroplasty.
[a]*Includes 76 patients receiving primary THA.*

whether they were candidates for hypotensive anesthesia.[41] Similarly, Bonnett et al[39] observed no deaths in 2 patients undergoing revision surgery in a series of 105 primary and 2 revision THAs. Sparling et al[11] and Wittmann and Wittmann[12,13] reported successful outcomes in a series of 5 healthy patients. However, Sparling et al's[11] patients were healthy (mean age, 66 years) and undergoing revision for aseptic causes. Patients with cardiovascular disease, hypertension, seizures, or occult blood loss were specifically excluded.[11] The clinical circumstances of the patients described by Wittmann and Wittmann[13] were unclear because comorbidities were not mentioned, and the only outcome reported was a mean postoperative hemoglobin of 7.2 g/dL. In contrast, a general study of revision THAs by Miller et al[42] reported a 0.87% three-month mortality rate in 807 revision THAs performed between 1970 and 1996 in a community setting.

Although recent studies of Jehovah's Witnesses have demonstrated resilience to acute blood loss, postoperative anemia is closely associated with postoperative mortality. Animal studies have demonstrated tolerance of a hemoglobin concentration between 2 and 5 g/dL,[8] with similar results in healthy human volunteers.[21] In contrast, increased mortality is observed in patients who have intraoperative blood loss greater than 500 mL, with a 2.5-fold increase in mortality for every 1-g/dL drop in hemoglobin concentration below 8 g/dL.[8,11,43] In a study of 300 surgical patients who refused transfusion and who had a hemoglobin concentration less than 8 g/dL, Carson et al[43] reported 0% mortality with a hemoglobin concentration more than 7 g/dL, 34% with less than 5 g/dL, 54% with 2 to 3 g/dL, and 100% with less than 2 g/dL. In another study of 8787 hip fractures, Carson et al[44] noted no mortality difference at 30 and 90 days postoperatively between transfused and nontransfused patients with a hemoglobin more than 8 g/dL. Although reports exist of patients surviving with a hemoglobin less than 1.5 g/dL,[45,46] it is extremely rare because hemoglobin less than 3 g/dL approaches the lower limit of cardiac compensation to anemia.[47] Similarly, increases in patient morbidity are also mirrored by a decrease in the hemoglobin concentration.[43] Cognitive function declines at hemoglobin levels below 6 g/dL, and memory is impaired at hemoglobin levels below 5 g/dL.[8,48] Smaller decreases in the hemoglobin concentration increase patient fatigue, which may affect physical therapy and delay hospital discharge.[17] Thus, it is important to maintain hemoglobin levels to prevent rapid physical and mental decompensation, especially in elderly patients and those with multiple comorbidities.

Conclusion

Revision THA is a viable treatment option for healthy Jehovah's Witnesses who can be preoperatively optimized, although significant risks are associated with major surgery in patients who cannot accept blood transfusions. Although most Jehovah's Witnesses can tolerate significant hemoglobin drops, at a certain hemoglobin concentration an inflection point exists where patients begin to rapidly deteriorate. It is imperative to plan for contingencies in the event of unexpected blood loss, which may include early termination of the procedure and completion in a staged fashion.

A standardized blood management program presents treatment options. Patients should be medically optimized preoperatively, and measures should be taken to minimize intraoperative blood loss. Patients must be educated about transfusion alternatives and the higher risks associated with revision surgery. High-risk surgical patients with multiple medical comorbidities must be warned about the chances of prolonged hospitalization and the risk of death. However, if surgeons familiarize themselves with blood management treatment protocols and adequately evaluate and optimize patients preoperatively, surgery on Jehovah's Witnesses can be performed safely with favorable clinical outcomes.

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