"Bloodless" Neurosurgery Among Jehovah's Witnesses: A Comparison with Matched Concurrent Controls

Douglas A. Hardesty[1], Sean Doerfler[1], Sukhmeet Sandhu[1], Robert G. Whitmore[2], Patricia Ford[3], Scott Rushton[4], Peter D. LeRoux[4]

■ BACKGROUND: **Jehovah's Witnesses (JW) are a Christian faith with >1 million members in the United States who do not accept autologous blood transfusions. The optimal management of these patients undergoing neurosurgical procedures is not well defined. Here, we examined the feasibility and safety of JW undergoing neurosurgery in a blood management program.**

■ STUDY DESIGN AND METHODS: **Sixty-eight JW patients including 23 men and 45 women (mean age 53 ± 12 years) who underwent a variety of cranial (n = 19) and spinal (n = 49) neurosurgical procedures during a 5-year period were identified retrospectively and their hospital charts, anesthetic records, and operative reports reviewed. A concurrent cohort of sex-, age-, and procedure-matched non-JW controls also was identified.**

■ RESULTS: **Among JW patients, a cell-saving system was used in 27 cases, with blood retransfused in 13 cases. Lactated Ringers solution was used extensively intraoperatively; albumin was given to 15 patients. The median decrease in hemoglobin was 2.1 g/dL. One patient had a postoperative hemoglobin value <7 g/dL. One patient returned to the operating room to revise a lumbar pedicle screw, and one patient had postoperative seizures. No cardiopulmonary complications, sepsis, pneumonia, or wound infection were observed. Compared with the matched control group, similar outcome results were observed. Blood loss and operative time also were similar in JW patients and controls.**

■ CONCLUSIONS: **Neurosurgical procedures in Jehovah's Witnesses are feasible, safe, and have similar outcomes to patients willing to accept transfusion when managed within a multidisciplinary blood-management program.**

INTRODUCTION

Transfusion practices have changed since the Transfusion Requirements in Critical Care trial in 1999[1] and today a restrictive blood transfusion strategy (hemoglobin [Hgb] ~7 g/dL) is preferred in general critical care and many surgical patients without serious cardiac disease.[2-4] In part, this has led to the development of "blood management" and the successful application of transfusion-free management even of gastrointestinal bleeding[5]; however, the optimal Hgb and transfusion trigger for neurosurgical patients are still being elucidated, and there is great variance in how these patients are transfused.[6-10] This applies to both patients admitted to the intensive care unit or who undergo elective surgery. In addition, it appears that results from general critical care or other surgical disciplines may not apply to neurosurgical disorders.[11]

The Jehovah's Witnesses (JW), a religious group of >7 million people in more than 200 countries, including >1 million in the United States, teach its followers to not accept autologous blood transfusions. This creates potential medical, surgical, and ethical challenges for these patients and caregivers. In particular, the choice not to receive a transfusion poses difficulty for the patient, anesthesiologist, and surgeon when deciding on the surgical treatment of any disease. The unique challenges for JW patients are described mainly in cardiothoracic surgery but also in otolaryngology, obstetrics, orthopedic, bariatric, and plastic surgery. In general these clinical series suggest that elective surgery without transfusion, including high-risk procedures such as open-heart surgery[12-20] and liver transplantation,[21,22] can be carried out with

Key words
- Jehovah's Witness
- Neurosurgery
- Transfusion

Abbreviations and Acronyms
ANH: Acute Normovolemic Hemodilution
Hgb: Hemoglobin
JW: Jehovah's Witness

From the [1]Department of Neurosurgery, University of Pennsylvania Health System, Philadelphia, Pennsylvania; [2]Department of Neurosurgery, Lahey Hospital and Medical Center, Peabody, Massachusetts; [3]Department of Hematology, University of Pennsylvania Health System, Philadelphia, Pennsylvania; and [4]Lankenau Brain and Spine Center, Lankenau Hospital, Wynnewood, Pennsylvania, USA

To whom correspondence should be addressed: Peter D. LeRoux, M.D. [E-mail: lerouxp@mlhs.org]

Citation: World Neurosurg. (2017) 97:132-139.
http://dx.doi.org/10.1016/j.wneu.2016.09.028

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

similar results to those patients who accept transfusions[11,23-29] when a multidisciplinary blood management approach is used. Furthermore, the refusal to accept transfusion does not appear to increase the risk for surgical complications or long-term mortality; however, emergency surgery or acute blood loss may be associated with increased morbidity and mortality among JWs,[30] and up to one-third of the patients with a postoperative Hgb <6 g/dL may die.[31]

There is a paucity of information on transfusion practices during neurosurgery and in particular among JW patients who undergo cranial or spinal procedures.[32-36] We therefore undertook this observational study to compare JW patients with matched non-JW control patients who underwent elective neurosurgery. We hypothesized that surgery in neurosurgical patients who refuse allogenic transfusion is feasible and as safe as in patients who accept transfusion.

CLINICAL MATERIALS AND METHODS

Study Population

Patients admitted during a 5-year period were identified retrospectively from a prospective observational database with institutional review board approval according to the following inclusion criteria: 1) age ≥18 years, 2) JW, and 3) underwent a neurosurgical procedure that required general anesthetic. Exclusion criteria included: 1) surgery performed for neurosurgical trauma or 2) history of a previous neurosurgical procedure. Age-, sex-, and procedure-matched controls accepting transfusion and treated in the same years as the JW patients also were identified.

Patient Care

All patients were enrolled in and evaluated as part of a comprehensive, multidisciplinary blood management program. This included evaluation by a hematologist and reviewing and signing an advance medical directive that provides specific instructions on what blood products, medications, and procedures each patient finds acceptable. Patients met with a nutritionist and added iron and nutrients to their daily diet from iron-rich food sources or iron supplements, if time permitted. Patients were expected to stop smoking and alcohol consumption 7 days before elective surgery, and over-the-counter or prescribed medications, for example, nonsteroidal anti-inflammatory drugs, anti-platelet agents, or anticoagulants, and natural supplements, for instance, ginkgo bilboba, that hinder or inhibit blood clotting were stopped before surgery. When applicable, preoperative anemic or iron-deficient JW patients (based on definitions from the World Health Organization) were treated at the discretion of their hematologist in advance of surgery with erythropoietin or iron transfusion.

Surgery and Anesthesia

Elective or nonemergency surgery was scheduled when Hgb levels were optimal (Hgb ≥10 g/dL or if <10 g/dL an increase in 1–2 g/dL had been observed with treatment). Surgical procedures were performed with standard techniques but with special emphasis on blood-conservation strategies, for example, the use of topical medications to help reduce bleeding and help with blood clotting, use of an ultrasonic scalpel along with electrocautery and using smaller tubes, limiting blood sampling, and conducting multiple tests per blood draw. All patients underwent general anesthesia. The exact technique was at the discretion of the anesthesiologist based on the procedure, and the patients perceived cardiovascular reserve. Techniques such as use of a cell saver or intraoperative blood salvage techniques, acute normovolemic hemodilution (ANH), deliberate intraoperative hypotensive anesthesia, and use of agents such as desmopressin, aminocaproic acid, and vitamin K were available. Blood substitutes to act as oxygen carriers such as perfluorocarbons and Hgb substitutes were not used.

Data Collection and Analysis

Patient hospital charts, imaging studies, anesthetic records, and operative reports were reviewed. From these records, age, sex, type of procedure, pre- and postoperative Hgb, estimated operative blood loss, length of operation, the use of cell-saving devices and other adjuvants, length of stay, complications within 30 days of surgery, and outcome were identified. Our main outcome measures were postoperative Hgb, complications, in-hospital mortality, 30-day survival, and readmission within 30 days of discharge. All analyses were performed with SAS version 9.2 (SAS Institute Inc., Cary, North Carolina, USA). Differences between groups were analyzed with the Student *t* test for continuous variables and the χ^2 test for categorical variables if normally distributed, or the Mann-Whitney U or Fisher test for nonparametric analysis. A *P* value of <0.05 was considered statistically significant.

RESULTS

Demographics

Sixty-eight JW patients, mean age 53 ± 12 years, were included in this analysis (Table 1). There was an almost 2:1 female

Table 1. Patient Demographics and Outcomes

	JW Patients	Controls
Number	68	68
Age, years	53 ± 12	53 ± 12
Male:female	23:45	23:45
Cranial:spine	19:49	19:49
Mean preoperative hemoglobin, g/dL	13.5 ± 1.5	13.8 ± 1.4
Median hemoglobin decrease, g/dL	2.1	2.3
Postoperative Hgb < 7, *n* (%)	1 (1.5%)	0
No. intraoperative blood transfusions	0	5 (7.4%)
In-hospital mortality, *n* (%)	0	0
Myocardial infarction	0	1 (1.5%)
Sepsis, *n* (%)	0	1 (1.5%)
Pneumonia, *n* (%)	0	0
Wound infection, *n* (%)	0	0
Average hospital length of stay, days	3.8 ± 4.6	4.97 ± 5.2

Controls were patients matched for age, sex, and surgical procedure who accept allogenic transfusion.
JW, Jehovah's Witness patients who refuse allogenic blood transfusion; Hgb, hemoglobin.