Published in final edited form as:

Urol Pract. 2020 July ; 7(4): 299–304. doi:10.1097/UPJ.000000000000108.

Routine Postoperative Hemoglobin Assessment Poorly Predicts Transfusion Requirement among Patients Undergoing Minimally Invasive Radical Prostatectomy

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Abstract

Introduction: An advantage of minimally invasive radical prostatectomy over open surgery is decreased blood loss. At our institution hemoglobin is routinely checked 4 and 14 hours postoperatively. We assessed the relevance of this practice in a contemporary cohort undergoing minimally invasive radical prostatectomy.

Methods: We retrospectively reviewed data from patients undergoing laparoscopic or robotic radical prostatectomy at our institution between January 2010 and September 2018. We identified 3,631 patients with preoperative and postoperative hemoglobin values, and assessed the role of routine hemoglobin assessment in determining need for transfusion within 30 days. Medicare reimbursement rates for 2019 were used for cost analysis.

Results: Of 3,631 patients in our cohort 44 (1.2%) required transfusion. At 4 hours following surgery the median hemoglobin decrease was 8.0% (IQR 4.8 to 11.4) for patients who did not receive transfusion and 12.5% (9.5 to 19.2) for those who received transfusion. At 14 hours the median decrease was 14.2% (IQR 10.0 to 18.4) vs 33.1% (22.6 to 38.6). Routine hemoglobin assessment had no role in the decision to transfuse in 18 patients (41%). No patient was transfused based on 4-hour values alone. Omitting 1 hemoglobin assessment could have resulted in institutional savings of \$37,000 during this period.

Conclusions: As transfusion following minimally invasive radical prostatectomy is rare, scheduled postoperative hemoglobin assessments in the absence of symptoms are unnecessary to recognize bleeding events. The largest hemoglobin difference between men who did vs did not receive transfusion was seen at 14 hours postoperatively. Thus, this single hemoglobin evaluation is sufficient.

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Keywords

prostatectomy; postoperative care; prostatic neoplasms; postoperative hemorrhage; postoperative complications

An estimated 140,000 radical prostatectomies are performed yearly in the United States, with at least 85% being conducted robotically.¹ Widespread use of ERAS protocols after minimally invasive radical prostatectomy allows same day or 1-night recovery in many cases.^{2,3} Among the benefits of minimally invasive radical prostatectomy compared to the open approach are decreased mean blood loss and reduced rates of transfusion.^{3,4} Recent series indicate transfusion rates between 0.4% and 5%.⁴⁻⁷ Among experienced centers operating times between the surgical approaches are comparable.⁷

Many centers use postoperative pathways that include routine laboratory evaluation. Postoperative hemoglobin levels are commonly taken at designated times to assess for bleeding following MIRP. Although stable or normal hemoglobin levels are reassuring, and declining levels are possibly concerning, the role of routine postoperative hemoglobin evaluation in assessing hemorrhage following MIRP is unclear.

Overuse of medical tests, including laboratory testing in the perioperative period, has been the topic of increasing interest due to cost containment concerns and questions relating to their clinical value.⁸ Studies indicate that many routinely ordered preoperative laboratory tests are of limited clinical utility, and that preoperative laboratory assessment should be individualized to the patient and the surgery rather than routine.⁹⁻¹¹ Similar consideration of routine postoperative laboratory values has been undertaken in many surgical disciplines, including gynecology and orthopedic surgery.¹²⁻¹⁴ The Society of Hospital Medicine partnered with the American Board of Internal Medicine Foundation to provide recommendations through their Choosing Wisely initiative to help clinicians address overuse of medical tests, which include the recommendations 1) to avoid transfusions of red blood cells for arbitrary hemoglobin thresholds in the absence of symptoms and 2) not to perform repetitive complete blood count and chemistry testing in the face of clinical and laboratory stability.¹⁵ Routine hemoglobin testing following MIRP in the absence of symptoms violates both recommendations.

To our knowledge, no previous study has evaluated the routine use of hemoglobin testing following MIRP. We describe the trends in hemoglobin values routinely obtained per ERAS pathway at our high volume cancer center. We assessed the role of routine hemoglobin testing following MIRP and its utility in guiding postoperative care. Furthermore, we sought to examine the cost of routine postoperative hemoglobin testing to our health care system to determine the clinical and economic efficiency of obtaining routine laboratory evaluation following MIRP.

Materials and Methods

Using a prospectively maintained database of surgical cases, we retrospectively reviewed data from 3,749 men who underwent MIRP (laparoscopic or robot-assisted) by 1 of 12

surgeons at our institution between January 2010 and September 2018. MIRP was completed successfully without concomitant procedures in 3,631 patients who also had complete hemoglobin values drawn preoperatively as well as postoperatively at 4 and 14 hours. Only patients with hemoglobin values at each time point who had sufficient followup to evaluate need for transfusion within 30 days postoperatively were included in the analysis. Preoperative hemoglobin was included if it was drawn within 30 days of the procedure. Postoperative values were included if they were drawn within 30 minutes of prescribed time based evaluation at both 4 and 14 hours postoperatively. Interventions for bleeding and transfusions within 30 days postoperatively were recorded. Approval for this study was granted by our institutional review board.

Our goal was to describe the changes in hemoglobin values from the preoperative to postoperative state, and to determine whether routine postoperative hemoglobin draws at 4 and 14 hours have clinical relevance. Absolute differences and percent changes in hemoglobin were calculated for each time point (baseline, and 4 and 14 hours postoperatively) for all patients, those who received transfusion and those who were not transfused. We used 2019 Medicare reimbursement data to evaluate costs for postoperative laboratory evaluations. Wilcoxon rank-sum test was used for continuous variables and Fisher exact test for categorical variables. All statistical analyses were conducted using Stata® 15.0.

Results

Patient clinical and demographic characteristics are summarized in table 1. Of the 3,631 men who underwent MIRP during the study period and also had complete hemoglobin values drawn preoperatively and postoperatively 44 (1.2%) received a blood transfusion. Median number of units transfused was 2 (IQR 2 to 3). While the median estimated blood loss was similar between the transfused and nontransfused groups, older patients with higher EBL were more likely to be transfused than younger patients with lower EBL. ASA® score, race and clinical stage did not impact rates of transfusion. Patients who were transfused had a shorter operating time than those who were not. However, surgery was a median of only 11 minutes shorter when comparing transfused vs nontransfused patients.

We observed no difference in transfusion rates between laparoscopically and robotically performed prostatectomies ($p=0.3$). Furthermore, performance of a pelvic lymph node dissection or extent of dissection was not associated with subsequent requirement for postoperative intervention or transfusion ($p=0.7$). Finally, extent of nerve sparing was not associated with transfusion or concern for postoperative bleeding ($p=0.2$). Analysis of these findings is detailed in table 1.

Among all men undergoing MIRP the median decline in hemoglobin was 1.1 gm/dl from preoperative to 4-hour postoperative value and 2.0 gm/dl from preoperative to 14-hour postoperative value (table 2). Among men who required transfusion hemoglobin had declined by 1.8 gm/dl at 4 hours and by 4.7 gm/dl at 14 hours postoperatively. Median percent change from preoperative to 14-hour postoperative evaluation in men who were transfused was 33.1%.

We found that hemoglobin assessment (whether at 4 or 14 hours postoperatively) had no role in the decision to transfuse in 18 of 44 cases (41%) following MIRP. Transfusion in these patients was indicated based on clinical factors, including cardiac risk factors (2 patients), blood or clotting factor disorders (2) or delayed onset of symptoms in the absence of concerning laboratory findings at the 14-hour evaluation (14). In the other 26 men (59%) who received transfusions low 4-hour or 14-hour hemoglobin levels confirmed clinical symptoms of bleeding and were used in the decision to transfuse. Concomitant symptoms or signs of bleeding (orthostasis, hypotension, tachycardia, oliguria, port site bleeding) were seen before laboratory confirmation in 24 of the 26 cases (92%), while per protocol laboratory results alone identified bleeding that resulted in transfusion in only 2. Among the entire cohort 8 patients (0.2%) were returned to surgery for a secondary procedure to control bleeding. Although low hemoglobin was seen in each of these patients, the decision to intervene was based on clinical signs and symptoms of postoperative hemorrhage. No patient underwent intervention or transfusion based on decreased hemoglobin at 4 hours postoperatively unless symptoms of bleeding were present.

The decision about whether to transfuse a patient or perform a secondary procedure to control postoperative bleeding was based on a combination of clinical characteristics, patient risk factors (eg cardiac condition and requirement for anticoagulation) and laboratory values. No transfusion or secondary procedure was performed following the 4-hour hemoglobin value unless a patient exhibited symptoms of bleeding such as orthostasis, hypotension, tachycardia or port site bleeding. Delayed presentation of symptoms or slow decline in hemoglobin without early suspicion of bleeding beyond the 14-hour laboratory draw was seen in 18 men (41%) who were transfused. Lower hemoglobin values in the perioperative period were part of the clinical decision to transfuse 26 men (59%). Table 3 shows the timing of transfusion events, and table 4 outlines symptoms and signs noted among men who required transfusion.

The Medicare reimbursement rate for venipuncture with automated complete blood count was \$10.18 in 2019. Eliminating the routine 4-hour postoperative blood draw for hemoglobin testing in asymptomatic patients would have resulted in savings of nearly \$37,000 at our institution during the study period. More broadly, as of 2017 an estimated 119,000 MIRPs were performed yearly in the United States.¹ If each MIRP protocol reduced the automatic hemoglobin checks by 1 laboratory test, the estimated reduction in Medicare reimbursements could exceed \$1.2 million yearly.

Discussion

The widespread dissemination of robotic and minimally invasive technology has transformed the experience of prostatectomy, as the clear majority of procedures are now performed robotically rather than via an open or laparoscopic approach.¹⁶ We previously observed that clinically significant hemorrhage, defined as a decrease in hemoglobin of at least 30% or 4 gm/dl, receipt of a blood transfusion within 30 days of surgery or requirement for a secondary procedure to control hemorrhage, occurs in 4% of cases in the minimally invasive era.¹⁷ The current study evaluated the clinical role of routine postoperative hemoglobin monitoring in the contemporary era of MIRP. Although our transfusion rate was

low at 1.2%, our practice of routine postoperative hemoglobin assessment has persisted despite the uncertain role of time designated laboratory assessment in clinical decision making. We sought to determine whether protocols calling for scheduled postoperative laboratory evaluations result in the ordering of unnecessary tests.

Median overall percent change in hemoglobin values was 8.0% between the preoperative and 4-hour postoperative draw and 14.2% between the preoperative and 14-hour postoperative draw. These numbers are useful benchmarks when describing postoperative changes among men undergoing MIRP. Our overall transfusion rate of 1.2% is consistent with the 1.5% rate reported in the American College of Surgeons National Surgical Quality Improvement Program® database for men undergoing MIRP.⁷

Notably, the estimated blood loss during surgery did not differ significantly between the transfused and nontransfused groups, although older patients with higher EBL were more likely to be transfused than younger patients with lower EBL. Although a subjective assessment by the surgeon and estimation of blood loss in the suction canister by anesthesia were included in our estimation, these findings highlight difficulties in adequately assessing blood loss described in the literature.¹⁸ During the included period, closed suction drains were used at the surgeon discretion. Drain placement was neither routine nor common and did not change notably during the study period. High drain output, particularly early in the postoperative period, can indicate presence of a clinically significant hemorrhage. Among those with drains present only 4 patients experienced elevated drain output during the perioperative period. In the absence of drain output evaluation physical examination, vital sign monitoring and confirmatory laboratory evaluation were used to identify patients with postoperative bleeding events.

These findings can be useful when deciding whether to incorporate time based rather than symptom based laboratory assessment in the postoperative period for patients undergoing MIRP. ERAS and protocolized medicine have been observed to be helpful in improving pain control,¹⁹ time to discharge²⁰ and patient satisfaction.²¹ Our study suggests that time based rather than clinically based laboratory evaluations in uncomplicated MIRP are unnecessary and result in the overuse of laboratory medicine resources without providing benefit to patient care. We believe that routine hemoglobin assessment can be safely limited to a single 14-hour postoperative value in most men. Among healthy men without cardiac history or anticoagulant requirement it may be appropriate to limit postoperative hemoglobin assessment to those with clinical or vital sign changes.

Among the 44 patients who received transfusion 6 had cardiac conditions requiring either higher hemoglobin values or use of aspirin throughout the perioperative period, or early resumption of anticoagulation following surgery. Three patients had blood dyscrasias or clotting disorders that contributed to the need for transfusion. Of the 44 men who were transfused 20 had an ASA score of 2 and 24 had a score of 3.

Chamsy et al evaluated routine hemoglobin testing in 629 women following laparoscopic hysterectomy and found that all patients who received transfusion were symptomatic.¹² In addition, all symptomatic patients were more likely to undergo repeat hemoglobin testing.

Although the patients who were transfused had lower hemoglobin levels, in each instance the decision to intervene was based on signs and symptoms of hemodynamic compromise rather than absolute hemoglobin value alone.

Studies in the orthopedic literature have attempted to determine the need for routine hemoglobin measurements following total hip arthroplasty or total knee arthroplasty.^{13,14} Goyal et al retrospectively reviewed 487 contemporary patients who underwent total knee arthroplasty with use of tranexamic acid and observed a postoperative transfusion rate of 2.5%.¹³ They found that routine postoperative hemoglobin evaluation was not required if the preoperative hemoglobin was greater than 14.0 gm/dl. Trevisan et al similarly evaluated patients undergoing total hip arthroplasty and found that a preoperative hemoglobin level of 13 gm/dl or greater indicated a low risk of postoperative transfusion and that postoperative hemoglobin evaluation could be tailored based on clinical findings.¹⁴

A limitation of our study is that it is a retrospective review from a single high volume cancer center, which may limit generalizability. Although retrospectively analyzed, our surgical database is prospectively maintained and regularly reviewed for accuracy.

At least some of our routine postoperative laboratory assessments appear to be legacy based, relying on experiences from the era of open prostatectomy, which no longer applies in MIRP. With increasing use of MIRP much attention has been given to streamlining perioperative care to ensure rapid recovery and early discharge home. Evaluation of routine laboratory assessment should be part of this process. Of note, 7,262 hemoglobin panels were obtained solely based on protocol as part of routine postoperative care for 3,631 men who underwent MIRP at our institution between January 2010 and September 2018. Changes in management based on hemoglobin changes were made in only 2 cases, and hemoglobin levels had no role in the decision to transfuse 18 of the 44 patients requiring treatment for postoperative anemia. These findings indicate that clinical assessment identifies clinically significant hemorrhage without need for routine laboratory testing. Such routine testing is costly and does not add significantly to the postoperative care of patients following MIRP. Thus, eliminating routine scheduled postoperative hemoglobin assessments helps contain unnecessary costs without impairing clinical care.

Conclusions

In our large series of consecutive MIRPs bleeding events and transfusion were rare, which is typical in the MIRP era. A median decline in hemoglobin levels of 14.2% was seen among all MIRP patients 14 hours following surgery. Routine hemoglobin testing in the absence of symptoms rarely informs clinical decision making following MIRP. As no patient was treated with transfusion or followup surgery based on hemoglobin findings alone, we recommend eliminating routine testing at 4 hours postoperatively. Eliminating time based hemoglobin testing following MIRP in favor of symptom based evaluation can result in laboratory cost savings without compromising quality of care.

Abbreviations and Acronyms

EBL	estimated blood loss
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ERAS	enhanced recovery after surgery
Hgb	hemoglobin
MIRP	minimally invasive radical prostatectomy

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Table 1.

Patient characteristics stratified by blood administration

	No Transfusion	Transfusion	p Value
No. pts (%)	3,587	44	(1.2)
Median yrs age at radical prostatectomy (IQR)	62	65	(60–70) 0.024 (Wilcoxon rank-sum test)
Median ml/kg EBL (IQR)*	200	200	(125–300) 0.057 (Wilcoxon rank-sum test)
Median mins procedure duration (IQR)†	238	227	(194–253) 0.016 (Wilcoxon rank-sum test)
No. race (%):			0.4 (Fisher exact test)
Black	333	7	(16)
Other	204	2	(4.5)
Unknown	224	1	(2.3)
White	2,826	34	(77)
No. ASA score (%):			1 (Fisher exact test)
2 or Lower	2,025	25	(57)
3 or Higher	1,562	19	(43)
No. clinical T stage (%):			0.7 (Fisher exact test)
Below cT2	2,261	28	(64)
cT2	1,058	12	(27)
cT3	159	3	(6.8)
cT4	5	0	(0)
Unknown	104	1	(2.3)
No. robotic procedure (%)	2,864	38	(86) 0.3 (Wilcoxon rank-sum test)
No. pathological T stage (%):			0.5 (Fisher exact test)
Below pT2	2 (less than 0.1)	0	(0)
pT2	1,873	25	(57)
pT3	1,650	18	(41)
pT4	58	1	(2.3)
Unknown	4	0	(0)
Median nodes removed (IQR)	15	16	(11–21) 0.7 (Wilcoxon rank-sum test)
No. nerve sparing surgery (%):			0.2 (Fisher exact test)
None	62	2	(4.5)

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	No Transfusion	Transfusion	p Value
Bilat	3,304	39 (92)	(89)
Unilat	133	1 (3.7)	(2.3)
Unknown	88	2 (2.5)	(4.5)

* In 3,543 patients.

[†] In 3,622 patients.

Table 2.

Changes in hemoglobin values

	No Transfusion	Transfusion	Overall
No. pts (%)	3,587 (98.8)	44 (1.2)	3,631 (100)
Median preop Hgb vs 4-hr postop Hgb (IQR):			
Absolute change (gm/dl)	1.0 (0.5–1.6)	1.8 (1.3–2.8)	1.1 (0.6–1.6)
% Change	8.0 (4.8–11.4)	12.5 (9.5–19.2)	8.0 (4.8–11.5)
Median preop Hgb vs 14-hr postop Hgb (IQR):			
Absolute change (gm/dl)	2.0 (1.4–2.7)	4.7 (3.3–5.7)	1.0 (1.4–2.7)
% Change	14.2 (10.0–18.4)	33.1 (22.6–38.6)	14.2 (10.1–18.5)
Median 4-hr postop Hgb vs 14-hr postop Hgb:			
Absolute change (gm/dl)	1.0 (0.6–1.5)	2.3 (1.0–3.3)	1.1 (0.6–1.5)
% Change	8.3 (5.2–11.6)	18.7 (22.6–38.6)	8.4 (5.2–11.6)

Table 3.

Timing of transfusion

	No. Pts (%)
Preop	1 (2.2)
Day of surgery	4 (9.1)
Postop day 1	21 (47.7)
Postop day 2	8 (18.2)
Postop day 3 or later	10 (22.7)

Table 4.

Clinical indications transfusion

	No. Pts (%)
Orthostasis	11 (25)
Delayed Hgb drop with anemia	9 (20)
Hemodynamic instability	8 (18)
Hypotension	6 (14)
Cardiac history with recommended Hgb target transfusion trigger	6 (14)
Clotting factor disorder/blood dyscrasia	3 (7)
Tachycardia	1 (2)