



Original Research

Is Routine Hemoglobin Monitoring Necessary after Elective Hip and Knee Arthroplasty?

Orla Hennessy, MB, BAO, BCh, MCh^{*}, Kevin McSorley, MB, BAO, BCh, MCh

Orthopaedics Department, Galway University Hospital, Galway, Ireland

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ABSTRACT

Background: Many orthopaedic units measure hemoglobin (Hb) levels after primary joint arthroplasty to identify patients with postoperative anemia. With the refinement of surgical techniques, blood loss in primary arthroplasty has decreased. The aim of this study was to investigate the postoperative Hb monitoring and transfusion practices in our own institution after elective hip or knee arthroplasty.

Methods: We conducted a retrospective audit of all patients who underwent elective total hip or knee arthroplasty in Galway University Hospital between March 1 and June 1, 2019. We recorded when they underwent postoperative Hb testing, whether or not they had a drop of Hb, which would indicate transfusion (<8 g/dL), and whether or not they were transfused. In patients who underwent transfusion, a chart review was performed to establish the presence of factors that would have triggered repeat Hb testing.

Results: One hundred thirty-six patients underwent elective primary hip or knee arthroplasty in the period. All had a full blood count sent on the first postoperative day. None (0%) had a clinically significant (to < 8g/dL) postoperative Hb drop on day 1. Eighteen (13.2%) patients underwent repeat testing on day 2 or subsequently. Eight (5.9%) exhibited a drop in Hb to less than 8 g/dL, with a mean Hb drop of 4.26 (standard error of the mean \pm 0.862, standard deviation \pm 0.98), and 5 (3.7%) proceeded to undergo allogenic blood product transfusion. All 5 underwent documented indications for repeat Hb testing.

Conclusions: There is no evidence for performing routine Hb testing on day 1 after elective hip or knee arthroplasty. We recommend that postoperative Hb testing should only be carried out on patients with additional indications.

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Introduction

Primary hip and knee arthroplasties are common elective orthopaedic procedures carried out in institutions worldwide, and the number of these procedures carried out will continue to increase, given the presence of an aging population [1]. It is common practice in many orthopaedic units to measure hemoglobin (Hb) levels in the early postoperative phase after primary joint arthroplasty. The rationale behind this measurement is to facilitate the identification of patients with postoperative anemia at a level significant to require allogenic blood transfusion. However, with the

progression and refinement of surgical techniques, overall blood loss in primary arthroplasty has continued to decrease, and recent studies have shown that routine postoperative Hb levels may no longer be necessary [2]. Repeat phlebotomy is invasive, inconvenient, and even painful to patients and carries its own risks including those of hematoma, infection, and phlebitis [3]. In addition, unnecessary laboratory testing is one of the most common examples of medical overtreatment and contributes significant financial burden to institutions [4].

In addition, in other specialties, routine Hb testing has been shown to be associated with higher transfusion rates, with no reduction in overall morbidity or mortality [5]. Given the well-documented risks associated with blood transfusion, including that of surgical site infection in orthopaedic surgery, avoiding unnecessary transfusion should be a priority in postoperative patients [6–9]. In this audit, we aim to investigate the blood monitoring practices in our own institution on the first postoperative day after elective hip or knee arthroplasty and whether or not they impact

Ethical approval: This article does not contain any studies with human participants performed by any of the authors.

^{*} Corresponding author. St Helens, 20 Newcastle Road, Galway, Ireland. Tel.: +353833088493.

E-mail address: o.hennessy95@gmail.com

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patient care. We also aim to examine the number of patients undergoing allogeneic transfusion and whether or not there was a clinical indication for this.

Material and methods

We conducted a retrospective audit of the electronic laboratory records of all patients who underwent elective total hip or knee arthroplasty in Galway University Hospital over a 3-month period between March 1 and June 1, 2019. Demographics for each patient including the gender, approach, and average blood loss, as well as preoperative and postoperative hemoglobin levels, were collected. All patients underwent routine preoperative assessment in a joint anesthetics/orthopaedics clinic approximately 2–4 months before planned admission. Hb was measured at this stage, and if less than 11 g/dL, preoperative iron transfusion and/or blood-product transfusion was recommended followed by repeat testing. Elective intervention would be postponed until a satisfactory Hb (more than 11 g/dL) was achieved. On admission, all patients routinely underwent a repeat preoperative Hb check. In terms of operative approaches, 2 main approaches are used at our institution, the anterolateral and the posterior approaches. Tranexamic acid is used routinely in all elective hip and knee arthroplasties, and knee arthroplasty is routinely performed under tourniquet. Surgical drains are not routinely inserted. Other intraoperative methods used as standard include the use of diathermy to swiftly control bleeding and adequate blood pressure control by anesthetic colleagues. Average intraoperative blood loss for hip arthroplasty was less than 150 mL and for knee arthroplasty was less than 50 mL.

Using the local blood-ordering and blood-reporting system WebLab, all patients were audited on if and when they underwent postoperative Hb testing, whether or not they had a clinically significant drop of Hb, which would indicate transfusion (<8 g/dL with no comorbidities or <9 g/dL with cardiac comorbidities), and whether or not they were transfused. In patients who underwent transfusion, a chart review was performed to establish the presence of low preoperative Hb, clinical symptoms, significant intraoperative blood loss, and other factors that would have triggered repeat Hb testing postoperatively. A chart review was also conducted to establish the appropriateness of transfusion in each patient. Transfusion thresholds were in keeping with local guidelines that advise transfusion at Hb <8 g/dL with symptoms or <9 g/dL in those with cardiac comorbidities.

Results

In total, 136 patients underwent elective primary hip or knee arthroplasty in the elective unit of Galway University Hospital between March 1 and June 1, 2019. The demographic breakdown is summarized in Table 1. All 136 patients underwent a preoperative Hb measurement. All 136 had a full blood count sent as standard on the first postoperative day. Of 136 patients, none (0%) had a clinically significant postoperative Hb drop on day 1. Eighteen (13.2%) patients underwent repeat Hb testing on day 2 or subsequent days postoperatively. Of these patients, 8 (5.9%) patients exhibited a clinically significant drop in Hb to less than 8 g/dL with a mean Hb drop of 4.26 (standard error of the mean \pm 0.862, standard deviation \pm 0.98) and pretransfusion Hb of 7.74 (standard error of the mean \pm 0.182, standard deviation \pm 0.21), and 5 (3.7%) patients proceeded to undergo allogeneic blood product transfusion. In this instance, postoperative Hb testing had a positive predictive value of 62.5% for predicting a transfusion requirement in those with a Hb less than the set threshold. The negative predictive value was much higher at 100%, reflecting that no patients with an adequate postoperative Hb level underwent transfusion. The preoperative

Table 1

Patient operative demographics and transfusion rates per procedure.

Demographics	n (%)
Gender	
Male	63 (46%)
Female	73 (56%)
Operation	
Primary hip	94 (69%)
Primary knee	42 (31%)
Approach hip	
Anterolateral	90 (66%)
Posterior	46 (34%)
Transfusions	
Hip	3 (3%)
Knee	2 (5%)

positive predictive value was much lower at 10.5%, with a negative predictive value at 97.5%.

Of the 5 patients who were transfused, 3 (60%) had undergone total hip replacements and 2 (40%) had undergone total knee replacements. All 5 had documented indications for repeat Hb testing. Two had a preoperative Hb of less than 12 g/dL, one developed a postoperative hematoma, one had ongoing postoperative wound ooze, which prompted repeat Hb testing, and the final patient had persistently low blood pressure and fatigue postoperatively. As such, all 5 (100%) transfusions were deemed appropriate. Of the 5 patients, 4 were transfused 1 unit and the final 2 units. No repeat transfusions were required.

Discussion

From our findings, routine full blood counts on the first postoperative day offer no clinical benefit, as no patient exhibited an Hb drop significant enough to require blood transfusion within this time frame. This finding is in keeping with studies previously carried out in larger centers [10]. Patients who achieved a laboratory threshold indicative for transfusion did not exhibit an Hb drop until day 2 or later. This strongly indicates that if routine postoperative Hb testing is to be carried out, it should be delayed until 48 hours postoperatively. Even in this instance, the positive predictive value of a low Hb level postoperatively is only 62.5%, indicating that additional factors influence decisions to transfuse. In addition, all of the patients who had a significant Hb drop had preoperative, historical, or clinical indicators for repeat Hb testing. This would indicate that routine postoperative Hb testing may no longer be warranted and should only be carried out in patients who have indications. Such indications may be preoperative, intraoperative, or postoperative and would include factors previously reported to predict the need for postoperative transfusion [11–14]. Preoperative risk factors include the following: significant cardiac, renal, or other medical comorbidities that would contribute to a lower transfusion threshold, high-risk anesthetic assessment, or preoperative Hb less than 12 g/dL [1] (positive predictive value for transfusion 10.5%). Intraoperative factors would include large recorded intraoperative blood loss and increased time on the table. Postoperative factors include complications associated with blood loss such as hematoma or persistent wound ooze, symptoms of anemia including persistent dizziness, fatigue, or palpitations, and persistent derangements to routine observations including the blood pressure and heart rate, with no alternative explanation.

Our findings are overall in keeping with the current literature on the subject. A number of recent studies in both hip and knee [15] arthroplasties have consistently indicated that routine postoperative laboratory measurements may not be necessary in this elective cohort [1,10]. This may be particularly true of patients who

have undergone routine preoperative screening and have adequate Hb levels [11,16]. Low preoperative Hb levels are a consistent indicator of the need for postoperative transfusion [12,17]. A recent study by Yeh et al. [18] included almost 1500 patients and advised that a preoperative Hb of greater than 12.4 g/dL in those older than 70 years and 12.1 g/dL in those younger than 70 years could be used to predict the need for postoperative transfusion. This is in keeping with preoperative Hb targets used within our own institution.

Of note, in this study, all of our transfusions were found to be appropriate, and at 3.7%, our overall transfusion rate was low even in keeping with internationally published comparisons [19]. This low transfusion rate is likely to be linked to a number of factors. Transfusion rates have continued to drop in elective arthroplasty because of more widespread implementation of perioperative protocols that focus on preoptimization and also include interventions such as routine tranexamic acid use [20], tourniquets in total knee arthroplasty [21,22], and decreased operative times as a result of new equipment and techniques [23]. In our unit, all of our primary joint arthroplasties undergo a preoperative assessment at which their Hb and iron levels are also checked. Patients with an Hb level less than 10 g/dl at this assessment are considered for iron or blood transfusion preoperatively. The importance of this preoperative optimization has been previously discussed in the literature [24]. Indeed, studies have shown that with adequate perioperative protocols, blood loss in modern elective arthroplasty can be almost eliminated [25]. This includes the use of tranexamic acid and preoperative optimization including Hb levels and cessation of anti-coagulants, as well as techniques such as hypotensive anesthesia and adequate intraoperative surgical hemostasis.

However, despite the current evidence, low transfusion rates and overall advances in perioperative factors contributing to a decreasing need for transfusion and postoperative laboratory investigations are still routinely ordered in many units after elective primary joint arthroplasty. Given projected increase in demand for joint arthroplasty as our population continues to age [26], this practice of routine blood analysis is likely to continue to lose favor as blood conservation continues to improve. It is also recognized that transfusion rates may be higher with hip arthroplasty than with knee arthroplasty [24,27,28], which was reflected in our own findings (60% vs 40%). The authors speculate this may be due to the ability to apply a tourniquet in knee surgery [27] or potentially the lesser soft-tissue dissection required for access to the knee joint vs the hip joint. It is notable, however, that transfusion rates in general can be highly variable and this difference may not be significant [29–31].

Given the current economic climate within the public health service in Ireland, there are also significant financial factors to be considered. In our unit, the cost of running a single full blood count is approximately 3 euros, which in this study resulted in approximately 393 euros worth of unnecessary blood tests. Extrapolated over 1 year, this results in a waste of more than 1500 euros. Routine post-operative coagulation screens were also sent on each patient, which contributes to an additional cost of 2148 euros per year. This cost only reflects the laboratory equipment and reagent cost of running the test and does not take into account manpower costs such as trained phlebotomy hire, junior doctor time, laboratory staff time, and portering costs. This cost may also differ in different health-care systems, as laboratory costs and so forth can vary significantly across institutions and countries, as can the distribution of the burden of this cost. This has previously been well illustrated for transfusion-associated costs [32,33]. Given the current climate, there is also an environmental cost to be considered, as blood testing generates a significant amount of single-use plastics, confidential paperwork, and high-risk medical waste including sharps and blood-contaminated items. This medical-grade and contaminated waste has to be disposed of according to strict protocols, often via

incineration, and there are significant environmental and financial costs associated with this (health-care waste costs up to 1800 euro to dispose of per ton). As such, the elimination of unnecessary blood testing has both a financial and environmental impact, as well as reducing risk to patients from unnecessary tests.

Conclusions

Based on our findings, there is no evidence for performing routine Hb testing on day one after elective hip or knee arthroplasty and there is also a strong argument toward eliminating routine postoperative Hb testing in elective arthroplasty surgery without other indications. All patients transfused in this study had alternative indications for repeat Hb testing and were appropriately transfused. In addition, our overall transfusion rate is generally lower than that reported in the literature [19,34]. As previously discussed, blood testing contributes to additional patient risk and increases environmental and economic costs.

Conflict of interests

The authors declare there are no conflicts of interest.

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