

Original Article

Are we all guilty of under-estimating intra-operative blood loss during hip fracture surgery?



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ABSTRACT

Aim: To assess how accurately orthopaedic surgeons and anaesthesiologists estimate intraoperative blood loss during hip fracture surgery as part of the Surgical Safety Checklist (SCC).

Methods: A prospective study of 55 operations over 9 months. Pre- and post-operative estimations of blood loss were documented. Actual blood loss was determined by subtracting total amount of lavage fluid used from overall volumes in the suction bag and by weighing used swabs.

Results: Both, surgeons and anaesthesiologists, significantly underestimated intraoperative blood loss ($p < 0.001$).

Conclusion: Rather than numerical estimates, a more useful question within the SCC may therefore be: "Is excessive blood loss expected?"

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1. Introduction

Intraoperative blood loss impacts patient recovery, hampers rehabilitation and outcomes, and can contribute to morbidities such as acute kidney injury and organ failure.^{1,2}

Recognition of intraoperative blood loss as a factor in patient mortality and morbidity³ led to its addition as part of the World Health Organisation (WHO) commissioned Surgical Safety Checklist (SSC).⁴ The SSC is used by a majority of hospitals in the United Kingdom (UK) prior to commencement of surgical procedures. It offers an opportunity for risk evaluation and consolidates the team-approach to patient care. Implementation of the SSC has demonstrably improved morbidity and mortality for patients.^{5–8}

The specific question related to blood loss asks the operative team to consider estimated blood loss (EBL). Such an estimate can allow for preventive measures to be considered (e.g. intravenous tranexamic acid,⁹ local infiltration of surgical site with adrenaline¹⁰, or the use of auto-transfusion drains), and early treatment of acute bleeding (early request and infusion of blood products). Answers are invariably inaccurate and subjective.^{11,12} Such

inaccuracies reported in the literature vary, with EBL often being a fraction of the total amount actually lost.^{13,14} These reports focus on elective surgery as opposed to emergency trauma and hip fractures, a higher risk demographic where the effects of blood loss are more acute.

Our aim is to assess how accurately orthopaedic surgeons and anaesthesiologists estimate intraoperative blood loss during emergency hip fracture surgery.

2. Methods

2.1. Patients and measurements

The study ran prospectively between April and December 2011. No patients were excluded from this study. However, only operations observed directly by one of the authors were included, to ensure accurate and unbiased measurement and recording of data. Hence the cases were not consecutive.

Each theatre session was observed by one of the authors to record estimations of blood loss from the operating surgeon and anaesthesiologists, both prior to surgery (during the SSC) and immediately following the completion of surgery. The grade of the doctors was noted, as was the surgical procedure performed (e.g. hip hemiarthroplasty, dynamic hip screw, or proximal femoral nail).

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The actual volumes of suctioned blood and those from surgical swabs were recorded. Actual blood loss was determined by subtracting total amount of lavage fluid used from the overall volumes in the suction bag and used swabs. Blood in the swabs was determined by weight, with the assumption that one gram of blood is equivalent to one millilitre of blood. Eight orthopaedic surgeons and six consultant anaesthetists took part in this study. In each case, blood loss estimates were compared with actual blood loss, and the discrepancy calculated.

2.2. Statistical methods

Initially, the errors in each blood loss estimate were calculated, by subtracting the observed blood loss from what was predicted. Comparisons were then made between mean errors in the surgeon and anaesthetist groups, as well as between the pre- and post-operative periods using paired t-tests.

Estimated blood loss was plotted against actual blood loss, and a Pearson's correlation coefficient (r) calculated, to assess the degree of accuracy of the estimations. Bland–Altman plots were also produced, to demonstrate how the degree of error varying with the magnitude of measurement. Since actual measurements of blood loss are known, these values were used on the x -axis, instead of the average of the pairs of measurements, as is the convention when true values are unknown. Statistical tests were performed using IBM SPSS 22 (IBM Corp. Armonk, NY), with an alpha level of 0.05 designated as statistically significant.

3. Results

Eight orthopaedic registrars and six consultant anaesthesiologists participated. Our sample size was 55 procedures: 11 proximal femoral nails antirotation (PFNA), 28 cemented hemiarthroplasties and 16 dynamic hip screws (DHS). The quantity of blood lost was not found to differ significantly by surgery type ($p = 0.322$, Kruskal–Wallis test), with medians of 420, 444 and 300 ml respectively (Fig. 1).

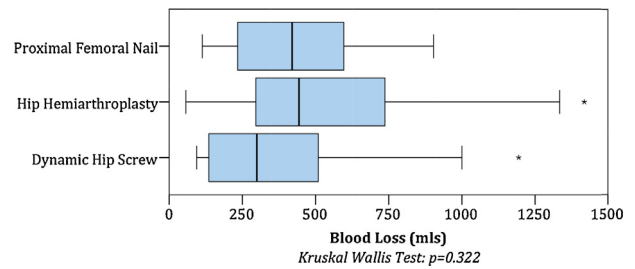


Fig. 1. The quantity of blood loss by surgery type

Table 1 compares the mean discrepancies between estimated and actual blood loss for both surgeons and anaesthesiologists. All four groups significantly underestimated the volume of blood lost ($p < 0.001$). The largest mean discrepancy of 249 ml (SEM: 45) was observed in the pre-operative estimations of surgeons. Anaesthetists were significantly more accurate at estimating blood loss than surgeons, with mean underestimates of 183 vs. 249 ml pre-surgery and 175 vs. 221 ml post-surgery (both $p < 0.001$). Blood estimations failed to improve significantly in accuracy when made prior to surgery in contrast to when made at the end of surgery amongst both surgeons ($p = 0.130$) and anaesthesiologists ($p = 0.631$).

Fig. 2 plots the relationships between actual and estimated blood loss within each group. There was no significant correlation detected between the actual and estimated values from surgeons ($p = 0.760$), with a correlation coefficient of -0.04 . In other words, surgeons consistently underestimated blood loss (mean -226 ml, SEM: 10), regardless of actual intra-operative blood loss. Anaesthesiologists performed marginally better in the pre-operative period, with a positive correlation between estimated and actual blood loss ($r = 0.294$, $p = 0.03$). However, they still had a tendency to considerably underestimate blood loss, with the discrepancy increasing with the magnitude of actual blood loss.

The reason behind these poor correlations was that both surgeons and anaesthesiologists tended to consistently give the

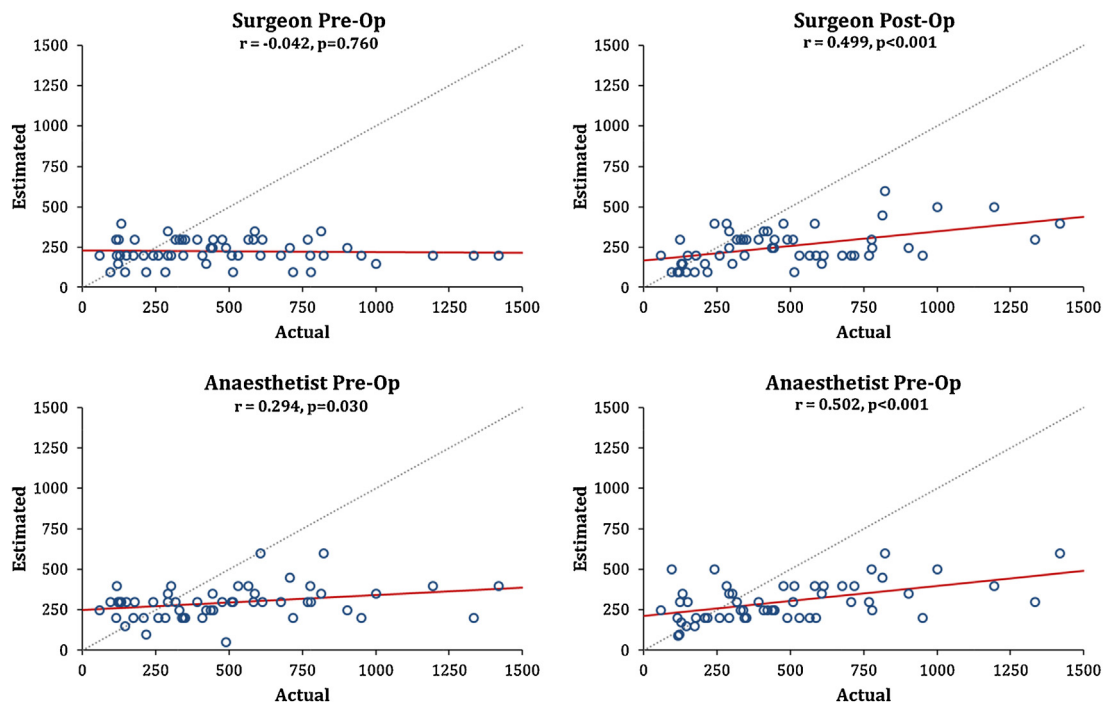


Fig. 2. Plots of actual vs. estimated blood loss by specialist and time. Broken lines are plotted at actual = estimated, and so are the target for accurate estimation. Red lines are from linear regression models.

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