

Measured vs calculated blood loss at cesarean delivery: correlation and practical use

Dr Graham White, Dr Andrew Clark, Department of Anaesthesia, Ayrshire Maternity Unit, Scotland, UK

Introduction

- During cesarean delivery (CD) a strategy to promote adequate Hb for O₂ transport while minimising unnecessary blood transfusion is highly desirable
- In 2020 MBRRACE-UK published a new recommendation: To ensure response to obstetric haemorrhage is tailored to the proportionate blood loss as a percentage of circulating volume based on a woman's body weight¹
- In non-pregnant surgical patients allowable blood loss calculators have been validated and used to guide intra-operative investigations, resuscitation and transfusion²
- This study aimed to assess correlation of measured blood loss at CD, from swabs and suction, with calculated blood loss from lab values to evaluate potential accuracy of allowable blood loss calculation at CD



VS



Maximum Allowable Blood Loss (ABL) Without Transfusion ☆

Estimates the maximum allowable blood loss intraoperatively before transfusion should be considered.

When to Use ▼
Pearls/Pitfalls ▼
Why Use ▼

≡

MD+
CALC

Age

Adult man
Adult woman
Infant
Neonate
Premature neonate

Example of an online allowable blood loss calculator

Gross² formula for evaluating allowable blood loss:

$$ABL = EBV \times \left(\frac{Hb_1 - Hb_2}{Hb_{av}} \right)$$

ABL = Allowable Blood Loss

EBV = Estimated Blood Volume

Hb₁ = Starting Hb conc

Hb₂ = Final Hb conc

Hav = average of Hb₁ & Hb₂

- By using the lab values recorded pre and post CD, the blood loss can be calculated and compared with the recorded measured blood loss from the O.R.



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Methods

- Retrospective review of 1 year of all CDs at our maternity unit and data collected for
 - Patient demographics (height and booking weight)
 - Lab values of pre-op Hb and lowest post op Hb
 - Documented measured blood loss from O.R.
 - Exclusion of patients with >2000ml blood loss
- 901 CDs included in analysis
- 5 separate published methods of estimating maternal blood volume were compared to assess if we could accurately predict final Hb after measuring blood loss during CD
- To assess correlation, mean absolute error was calculated and limits of agreement displayed on Bland-Altman plots

Table 1: Summary of Correlation of measured and calculated blood loss

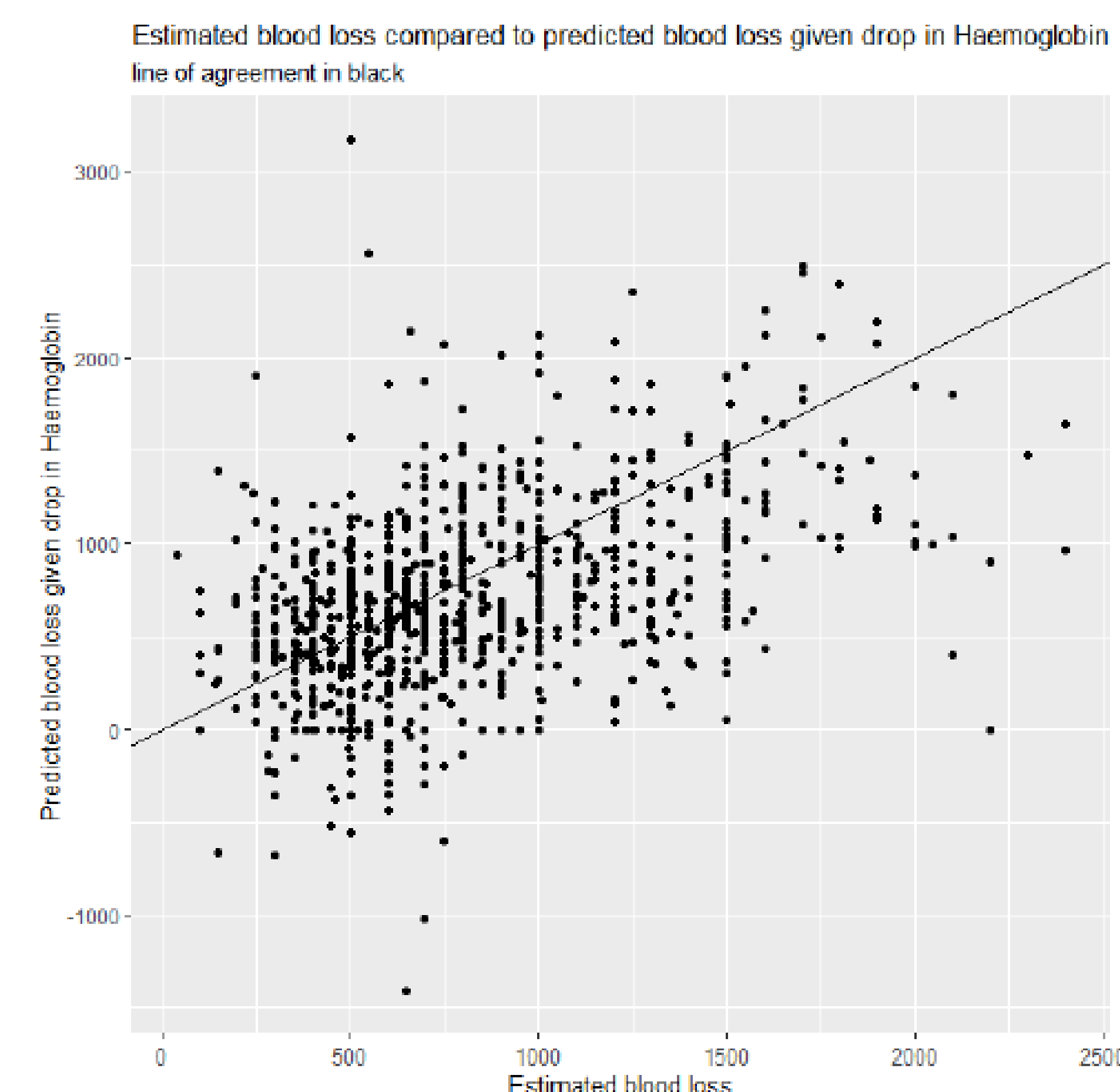
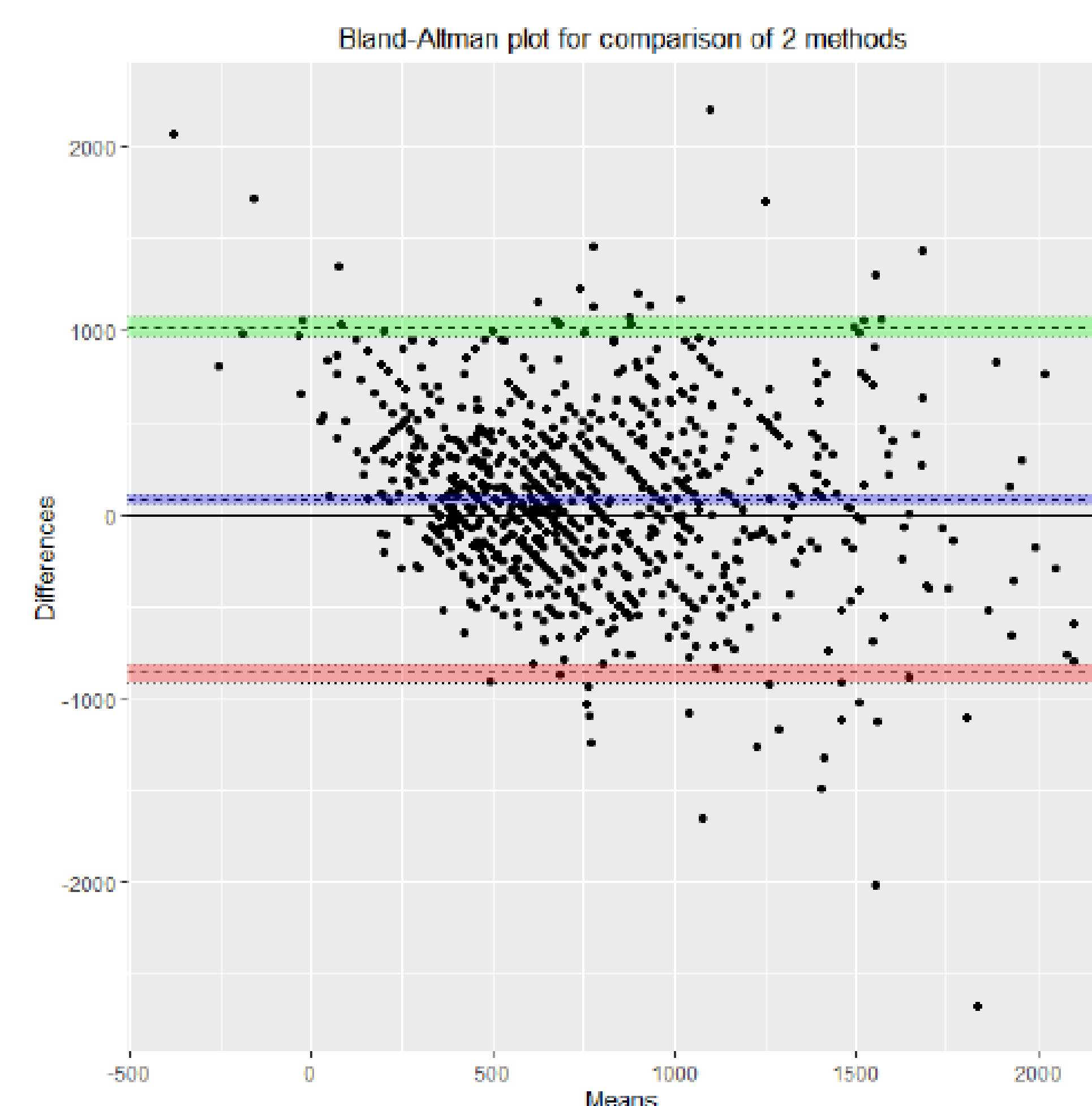
Model for predicted blood volumes (year developed)	Median [IQR] estimated blood volume (ml)	Median [IQR] calculated blood loss (ml)	Median [IQR] measured blood loss (ml)	Mean absolute error	Bland-Altman (95% CI): Bias; Upper Limit of Agreement; Lower Limit of Agreement (LoA)
Reference ³ + 50% 97.5ml/kg	8092 [7020, 9555]	692 [416, 1032]	700 [500, 1000]	381.0	Bias: 17.8 (-14.0, 50.6) Upper LoA: 998.0 (942.2, 1053.9) Lower LoA: -962.3 (-1018.2, -906.4)
Nadler ⁴ + 50% (1962)	6752 [6128, 7527]	574 [359, 845]	700 [500,1000]	348.9	Bias: 151 (123, 179) Upper LoA: 986.9 (939.3, 1034.6) Lower LoA: -683.7 (-731.3, -636.1)
Lemmens-Bernstein-Brodsky ⁴ + 50% (2006)	7804 [7168, 8471]	661 [409, 967]	700 [500, 1000]	356.9	Bias: 63.2 (32.8, 93.6) Upper LoA: 973.4 (921.5, 1025.3) Lower LoA: -846.9 (-898.8, -795.0)
Allen ⁵ + 50% (1956)	6779 [6154, 7574]	576 [359, 848]	700 [500, 1000]	349.1	Bias: 149.4 (121.5, 177.3) Upper LoA: 986.9 (939.1, 1034.6) Lower LoA: -688.1 (-735.8, -640.3)
Vricella ³ (2015)	7030 [6392, 7740]	597 [365, 876]	700 [500, 1000]	349.7	Bias:130.6 (102.2, 159.1) Upper LoA: 983.9 (935.3, 1032.7) Lower LoA: -722.7 (-674.1, -771.4)

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Results and Discussion

- All 5 models of estimated circulating volume perform similarly with very wide limits of agreement shown in Table 1
- 1 model (Lemmens-Bernstein-Brodsky) is shown opposite in a Bland-Altman plot to illustrate the wide agreements found in each model tested
- Limitations of this study include:
 - Retrospective and small data set
 - Assumption of pre-operative normovolaemia
 - Variable administration of intraoperative crystalloids and IV medications
 - Hidden blood loss at time of surgery
 - Unclear impact of uterine auto-transfusion
 - Non-standardised timings of post op Hb



Conclusion

- The wide limits of agreement, which approached 1L in either direction in all models, raises questions over its use clinically
- These margins of error are too large for it to be meaningfully utilised in clinical practice
- Modern statistical regression techniques may yield more precise estimates and a future prospective study will aim to use these to evaluate the relationship between estimated blood loss and the fall in Hb at CD

References

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