A new age-based formula: “the Michigan formula” is more accurate than common weight estimation methods in children undergoing anesthesia

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Introduction

Many therapeutic interventions in children undergoing surgery and anesthesia require an accurate body weight measurement. Occasionally extenuating circumstances make it impossible or impractical to weigh the patient, making weight estimation necessary. Many of the common equations for weight estimation in children were either introduced prior to the widespread prevalence of childhood obesity (1) or have not been assessed in overweight/obese children. Furthermore, none of these weight estimation equations have been validated in children undergoing anesthesia and surgery. Studies about pediatric weight estimation have traditionally come from Emergency Department (ED) data (2,3). Initial resuscitation is clearly of vital significance, however the importance of pediatric weight estimation extends beyond the ED. The weight that is estimated for resuscitation purposes is also used during the patient’s passage through other hospital departments including, radiology, the operating room, the intensive care unit and the regular ward.

Methods

- An existing cross-sectional anthropometric and clinical dataset on 15862 children ages 2-14yr was utilized to evaluate the performance of two commonly used pediatric age-based weight estimation formulae for the prediction of measured body weight.
- The weight of each child using the APLS formula (2 x age (in years) + 8) and the Luscombe formula (3 x age (in years) + 7) were calculated.
- To assess the ability of the formulae to predict measured weight, 75% of the study subjects were randomly selected (derivation cohort).
- Correlation coefficients and accuracy of predicted weight to within 10% of measured weight were calculated.
- Agreement between derived and measured weights was assessed using the Bland-Altman method to calculate precision and bias.
- Linear regression analysis was utilized to derive a new age-based formula (the Michigan formula) that could be used to estimate the weight of children undergoing anesthesia.

Results

- A total of 15862 children were studied
- Majority (69.3%) of the patients were of Caucasian ethnicity.
- The mean age of all the subjects was 7.4±3.6yr
- The mean weight was 28.8±15.6kg
- Both the APLS and Luscombe formulae had good positive correlations with measured weight (r=0.87; p<0.001)
- APLS formula consistently underestimated the weights of children in this study whereas the Luscombe formula had good accuracy.
- The newly derived Michigan formula (Fig 1): 4 x (age (in years)) + 6 demonstrated the best accuracy at estimating the weight of children in the validation cohort
- Michigan formula = 92% accuracy, Luscombe formula = 84% accuracy and APLS formula = 48% accuracy; p<0.001 (Table 1).

Conclusion

Two commonly used weight estimation formulae demonstrated low to moderate accuracy at predicting the weight of our study cohort. A new age-based formula (the Michigan formula) was developed and validated and it showed high accuracy and precision even in overweight/obese children. It needs to be validated in other pediatric population.

References

