

EDITORIAL

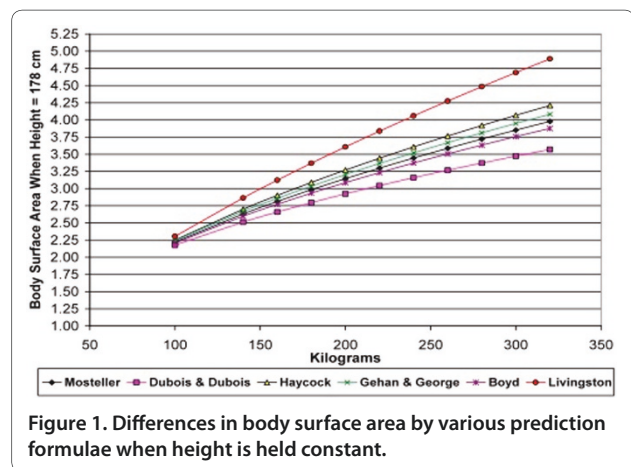
Indexed hemodynamic measurements may be inappropriate at body surface area extremes

Adam C Adler^{*1,2}, Brian H Nathanson³, Karthik Raghunathan^{1,2} and William T McGee^{2,4}

As the epidemic of obesity and morbid obesity [1] spreads and as more obese patients require intensive care, it is important to use appropriately body surface area (BSA) indexed hemodynamic measurements [2]. The idea of adjusting for variation in heights and weights while making comparisons was first described by DuBois and Dubois in 1916. Unfortunately, they derived their widely used formula based on only nine patients, none of whom were morbidly obese. Since then, multiple formulae have been proposed based on larger sample sizes, including those by Mosteller, Haycock, Gehan and George, Boyd, Fujimoto, and Livingston [3]. Only Livingston and colleagues made an explicit effort to include obese patients when deriving a BSA formula.

For normal to moderately obese patients, the various BSA formulae will produce similar values [3]. As weights increase disproportionately relative to heights, inter-formula variability for BSA calculation becomes clinically significant. Figure 1 shows the various BSA estimates for a hypothetical patient at a constant height of 178 cm but with variable weight from 100 to 325 kg. We see negligible differences between formulae at 100 kg but the calculated BSA values diverge as weight increases. This is because each formula is extrapolating to extreme body shapes based on derivations from mostly normal-sized patients. The lower indexed values may trigger a therapeutic intervention that may or may not be appropriate for the patient's true needs.

The best way to treat the morbidly obese critically ill patient is an active area of research. Generally, one does not treat the numbers knowing that BSA formulae are not empirically derived from a morbidly obese population. Livingston found that the DuBois and Dubois equation underestimated BSA by as much as 20% in obese patients [4], while Verbraecken and colleagues found a smaller but still significant underestimation in



obese patients with this formula. Most hemodynamic monitors such as Vigileo[®], LiDCO[®] and PiCCO[®] use the DuBois and DuBois formula to derive BSA, while the NiCOM[®] monitor uses the Mosteller formula [5].

We encourage colleagues to be aware of the extent of variation in the derivation of BSA, of the likelihood that the most commonly used formula is not appropriate for use in the morbidly obese patient population and of the fact that indexed measurements reported by typical monitors are not validated in the vulnerable morbidly obese population. We further recommend the use of unindexed values in the very morbidly obese.

Abbreviations

BSA, body surface area.

Competing interests

The authors declare that they have no competing interests.

Author details

¹Department of Anesthesiology, Baystate Medical Center, 759 Chestnut Street, Springfield, MA 01199, USA. ²Tufts University School of Medicine, 145 Harrison Avenue, Boston, MA 02111. ³OptiStatim, LLC P.O. Box 60844, Longmeadow, MA 01116, USA. ⁴Department of Medicine, Division of Critical Care, Baystate Medical Center, 759 Chestnut Street, Springfield, MA 01199, USA.

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*Correspondence: adamcadler@gmail.com

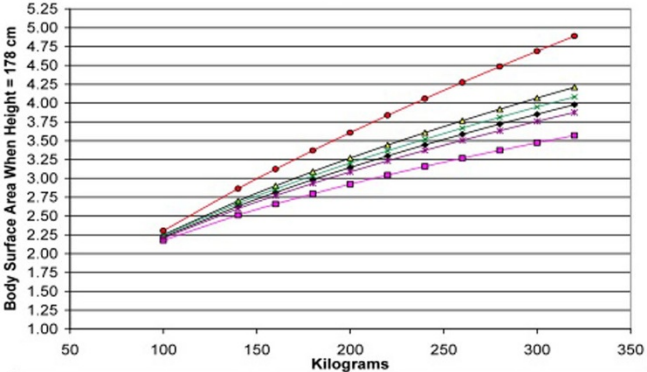
¹Department of Anesthesiology, Baystate Medical Center, 759 Chestnut Street, Springfield, MA 01199, USA

Full list of author information is available at the end of the article

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◆ Mosteller
 ■ Dubois & Dubois
 ▲ Haycock
 ✕ Gehan & George
 ✱ Boyd
 ● Livingston