

Predicting the Glomerular Filtration Rate in Bariatric Surgery Patients

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Commentary

By Professor Richard Glasscock

Equations for estimation of GFR (eGFR) from the serum levels of biomarkers (such as creatinine or Cystatin C) do not overtly include the variables of weight or body mass index (BMI), although they are adjusted to a 'standard' body surface (BSA) of 1.73 m² which, of course, contains both body weight and height variables. Only the Cockcroft-Gault (C-G) formula, which estimates endogenous creatinine clearance and not GFR per se, includes a body weight variable. The C-G equation is usually not further standardized to a BSA of 1.73 m² as such represents a 'double correction' for body weight. The properties and derivation of the eGFR formulas pose special issues for the obese subject (BMI >30 kg/m²), as exemplified by morbid obesity and Sumo wrestlers, in whom an adjustment for 'standard' BSA may lead to a serious underestimation of true or measured GFR (mGFR) as discussed by Delanaye et al. (Delanaye, P.; Krzesinski, J.M.: Indexing of renal function parameters by body surface area: intelligence or folly? *Nephron Clin Prac* 2011;119:c289–292). To further compound the difficulty, the usual eGFR equations (MDRD and CKD-EPI) have not been well validated in obese subjects against a gold-standard mGFR.

New and very valuable data has been added to help understand this conundrum by Friedman and colleagues. They studied 36 morbidly obese subjects (BMI = 46 ± 9 kg/m²; average BSA of 2.33 m²) before and after weight reduction (bariatric) surgery. Plasma iothexol clearance was used as a value for mGFR. The bias, precision and accuracy of various equations for eGFR (MDRD-creatinine, CKD-EPI-creatinine, CKD-EPI-cystatin C and CKD-EPI-cystatin C + creatinine) were evaluated pre- and post- surgery and with and without adjustment for BSA. The baseline pre-surgery mGFR was 87 ± 29 ml/min/1.73 m² and 117 ± 40 ml/min. After surgery, the subjects' BMI fell by 13 kg/m² (to 33 ± 8 kg/m²), body weight fell by 37 kg and

BSA decreased by 0.31 m² on average. The mGFR adjusted to BSA did not fall with the surgery induced weight loss, but mGFR not adjusted for BSA declined by an average of 17 ml/min post-surgery. On the other hand, the eGFR (by MDRD) increased by an average of 11 ml/min/1.73 m² after surgery and the eGFR-CKD-EPI-cystatin C increased by only 1 ml/min/1.73 m² after surgery. mGFR (in ml/min) declined in 19 subjects, increased in 5 subjects and remained the same in 5 subjects after surgery. About 1/3 of the subjects had a mGFR (in ml/min) that fell into the 'hyperfiltering' range of 130 ml/min or more. Few of these would have been detected by eGFR equations corrected for BSA. Overall, the eGFR-CKD-EPI-cystatin C + creatinine formula adjusted for BSA best predicted mGFR adjusted for BSA pre-surgery (bias = 1.0 ml/min/1.73 m²; precision (IQR of difference) 28.4 ml/min/1.73 m² and P30 accuracy of 81%). Creatinine-based CKD-EPI/MDRD equations performed very poorly. Interestingly, the eGFR-CKD-EPI-creatinine unadjusted for BSA over-estimated the mGFR, also unadjusted for BSA, (both in ml/min) by an average of 15 ml/min pre-surgery and by 17 ml/min post-surgery. The 'bottom-line' in my opinion is: 1) Standard creatinine-based eGFR equations (MDRD and CKD-EPI-creatinine) should not be used to estimate GFR in very obese subjects; 2) The correction of eGFR or mGFR for BSA is of dubious value in obese subjects; 3) 'Hyperfiltration' will be missed commonly if eGFR equations adjusted for BSA are used; 4) If true GFR cannot be measured and its value is needed (e.g for calculation of drug dosage), an eGFR-CKD-EPI-cystatin C + creatinine equation unadjusted for BSA appears to be best, but even this equation will under-estimate true GFR (by about 7%). Clinical laboratories reporting eGFR should take these facts into account.

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