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Is Umbilicocerebral Ratio better than Cerebroplacental Ratio for Predicting Adverse Pregnancy and Neonatal Outcomes?

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OBJECTIVE: A secondary analysis of the trial of randomized umbilical and fetal flow in Europe suggested that the umbilicocerebral ratio (UCR) provides better differentiation of neurodevelopmental outcome in the abnormal range compared to cerebroplacental ratio (CPR).[1] However, the reported superiority of UCR is controversial.[2] We aimed to compare the CPR and UCR for predicting operative delivery for presumed fetal compromise and prolonged neonatal unit (NNU) admission in term fetuses suspected to be small for gestational age (SGA).

METHODS: This was a retrospective analysis of singleton pregnancies with estimated fetal weight less than the 10th centile (SGA) at 36 weeks' gestation or beyond at St. George's Hospital in London between 1999 and 2015. CPR was calculated as the ratio of middle cerebral artery and umbilical artery pulsatility index, while UCR was calculated as the inverse of CPR. The outcomes were operative delivery for presumed fetal compromise and prolonged NNU admission (admission to the neonatal unit for longer than 48 hours).[3] Multiples of medians (MoMs) were calculated using the reference ranges reported by Acharya et al.[4] The predictive accuracy was assessed using receiver operating characteristics curves.

RESULTS: The analysis included 958 pregnancies. The incidence of operative delivery and prolonged NNU admission were 17.6% (169/958) and 4.7% (45/958), respectively. The CPR (median: 1.63 vs 1.51) and UCR (median: 0.61 vs 0.66) values were significantly different in fetuses who underwent operative delivery for presumed fetal compromise compared to those who did not (*P*=0.015 for both). There were no statistically significant differences in either UCR or CPR between those with and without prolonged NNU admission (*P*=0.230 for both). The number of outlier values without MoM correction was significantly more with UCR compared to CPR in those who did not have operative delivery for presumed fetal compromise (5.6%,44/789 vs. 1.6%,13/789 *P*<0.001) or prolonged NNU admission (5.0%, 46/913 vs 1.5%, 14/913 *P*<0.001).

The area under the curve (AUC) values of UCR and CPR for predicting operative delivery for presumed fetal compromise (AUC: 0.56, 95% CI: 0.51-0.61) or prolonged NNU admission were the same (AUC: 0.55, 95% CI: 0.46-0.64) (Figure 1).

There was a significant decrease in the AUC values for predicting operative delivery for presumed fetal compromise with UCR MoM (0.56 vs 0.53, *P*<0.001) or CPR MoM

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(0.56 vs 0.52, *P*<0.001) compared to raw values, while there was a significant increase in AUC values for predicting prolonged NNU admission with UCR MoM (0.57 vs 0.55, *P*=0.036) and CPR MoM (0.58 vs 0.55, *P*=0.048) compared to raw values. There were no significant differences between UCR and CPR MoMs (*P* =0.176).

CONCLUSION: The AUC values of CPR and UCR for predicting operative delivery for presumed fetal compromise or prolonged NNU admission were essentially the same. MoM standardization for gestational age changed the predictive accuracy for prolonged NNU admission and operative delivery for presumed fetal compromise. However, gestational age adjustment with MoM values may not be appropriate for UCR and CPR when gestational age is an intermediate factor between exposures and outcomes.[5] The changes in the predictive accuracy are likely to be caused by collider bias and may lead to erroneous conclusions.

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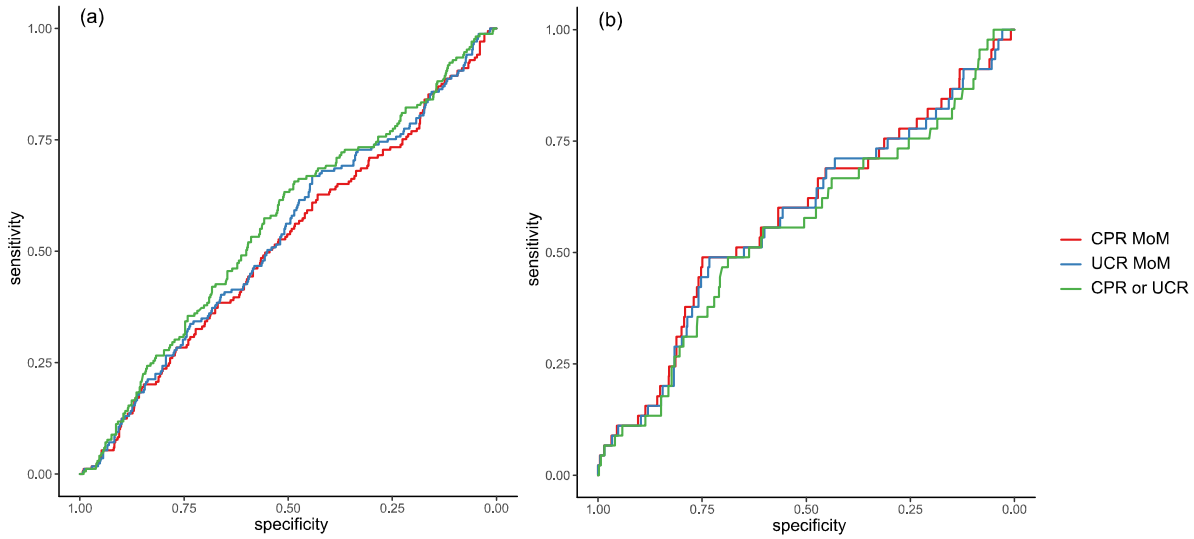

Figure 1. The receiver operating characteristics (ROC) curves for operative delivery for presumed fetal compromise (a) and prolonged neonatal unit admission (>48h) (b). The cerebroplacental ratio (CPR) and umbilicocerebral ratio (UCR) had overlapping ROC curves for operative delivery for presumed fetal compromise or prolonged neonatal unit admission. The MoM standardization decreased the area under the curve (AUC) values for operative delivery for presumed fetal compromise (P<0.001 for CPR and UCR), while they improved the AUC values for prolonged neonatal unit admission (P<0.05 for CPR and UCR).

MoM: multiple of median

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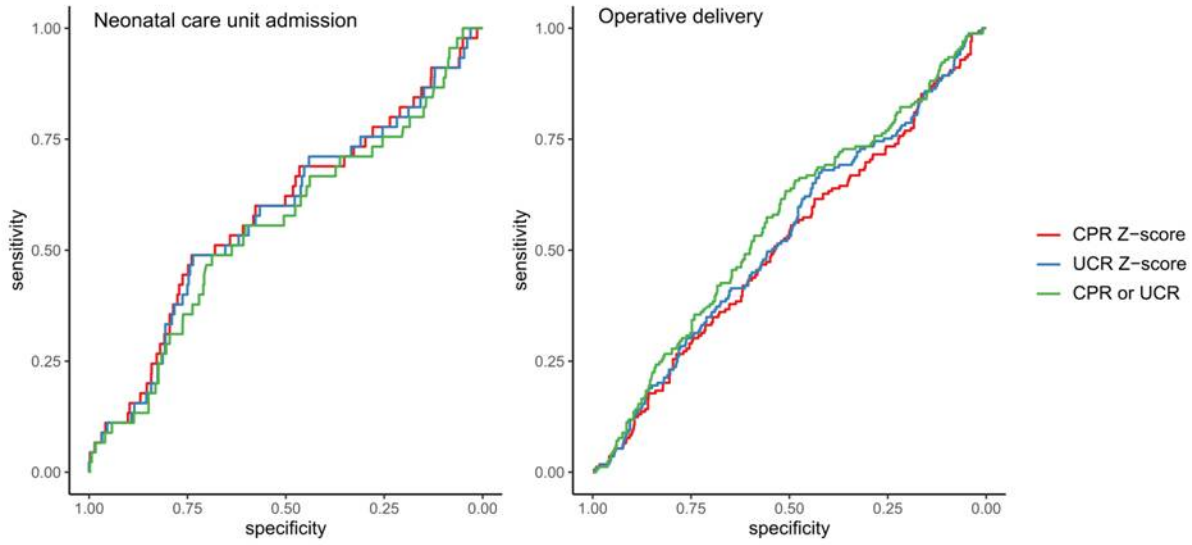

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