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How bad is it to fail at pushing hard and fast in pediatric CPR?

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Delivering high quality chest compressions is often summarized by the catchphrase, “Push Hard. Push Fast. Minimize Interruptions.” The implementation of this however can be problematic as pushing too fast may reduce compression depth and has been associated with worsened outcomes in adult cardiopulmonary resuscitation (CPR) studies.(1) Furthermore pushing hard and fast with minimal interruptions may produce “leaning”(2) which results in incomplete chest wall recoil reducing coronary and cerebral perfusion pressures.(3) Both leaning (2) and compression rates exceeding recommended goals (4) are common in pediatric CPR, particularly in younger children. Since most of the existing data on pediatric CPR quality derives from a single institution (Children’s Hospital of Philadelphia [CHOP]), it is noteworthy that authors from CHOP and a consortium of top children’s hospitals undertook the task of evaluating pediatric CPR quality in a multicenter setting as reported in this month’s issue of *Pediatric Critical Care Medicine*. (5)

The 2015 AHA guidelines (6) which establish recommended compression rates and depths for pediatric basic life support/CPR have significant limitations. The goal rates (100–120) are based on adult studies due to an acknowledged lack of pediatric data.(6) The optimal rate for adult CPR, based on outcomes, appears to be 125.(1) Given the increased chronotropic dependence of pediatric cardiac output relative to adults, this target may indeed be an underestimation. Goal compression depth is likewise based on a paucity of evidence. Compressions to one-half the sternal depth, compared to one-third, yield higher systolic blood pressures (7) and AHA compliant CPR depth (> 5 cm) in children older than 8 years old are associated with improved outcomes.(8) The guideline recommended compression depths are based on rounded anthropometric estimates of one-third the pediatric anterior-posterior diameter which is problematic when spanning large age ranges (e.g. 4 cm for ages 1–8 years old) where normal growth generates significant heterogeneity. The authors of this study (X) are to be commended for their use of smaller goal depths based on imaging data (9, 10) which better approximate the age of the patients in this study. Guideline compliant

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depth and rate are associated with better blood pressure during in-hospital CPR(11) though so were higher than recommended depth and rate (in combination but not individually).

The finding by Niles and colleagues that CPR quality falls short of the 2015 AHA guidelines is consistent with earlier single center findings.(4) The greatest shortcoming are found in achieving goal depths which are attained in as few as 17% of infants and 30% of children ages 1–8 years old. On the surface, this appears to reflect poor CPR quality at some of the top Children's hospitals. Yet these results must be interpreted with some important caveats. First, even at CHOP where CPR quality training is intensive, goal depths are rarely achieved (12) which raises the question how to best target and implement training. Second, the 2015 AHA guidelines erred on deeper compressions making the likelihood of failure to achieve the goals greater. Nonetheless, since rib fractures are very uncommon in pediatric CPR (13) it is unlikely that pushing deeper during CPR will cause harm and deeper compressions may improve generated perfusion pressures.(7, 8, 11) Finally it is surprising that compression depths were so shallow in this study since health care providers were not blinded to the feedback from the device measuring depth. Prior studies have demonstrated improvements in CPR quality with audiovisual feedback(2, 4, 14) leading one to question whether feedback needs to be delivered more effectively to improve compliance.

Ultimately, in determining optimal CPR targets in pediatric resuscitation what is sorely lacking is good outcomes data and experimental data of perfusion pressures based on the range of sizes which are encountered in growing children. In adults, a small but measurable decline in survival accompanied excessive compression depths, particularly in women(15) where one expects smaller body habitus. This large study (n=9136) examined early and late survival. No such study exists in pediatric cardiac arrest. Until we have such data we remain uncertain how sensible our targets are and how alarmed we should be at our failure to achieve them.

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