

Neonatal Bag Valve Mask Resuscitation Controlling for Tidal Volume

At birth, neonates must learn to breathe on their own after a long period of lung inactivity during gestation. This comes with a learning curve which differs from neonate to neonate, as 4.2% of all live births require assistance of some sort before gaining the ability to independently breathe. The window for such a diagnosis is short and requires immediate attention, as failure to receive oxygen will result in death. Healthcare providers respond to the situation using a bag valve mask (BVM) resuscitation system to deliver the clinically found tidal volumes of 4-6mL of air per kilogram of neonate weight. The harder the compression of the bag, the greater amount of air delivered. This demanding constraint may introduce strenuous circumstances for healthcare providers, often resulting in too great of a tidal volume delivery known as hyperventilation. This problem is amplified by the current standard for BVM resuscitation, in which healthcare providers deliver air to patients based on a pressure system. Furthermore, this is done with the same devices and practices to serve a wide range of patient sizes. This is critical, as this practice fails to recognize the nuanced and specific needs across such a wide range. Although this is not a completely inaccurate model, it is especially unaccommodating for neonatal patients (ranging from 0.5 to 5kg). This arises because the neonatal response to pressure based resuscitation does not suit their fragile lungs, resulting in 250,000 deaths globally (according to CDC estimates). To accommodate for these specialized needs and better serve neonatal patients, we hypothesized that the development of a new model that controls for tidal volume, as opposed to pressure, will result in a safer and more accurate method of delivering tidal volumes that are specific to neonates. To achieve this, we propose a retrofittable device that controls for tidal volume by placing guide handles around the bag, limiting the max distance by which a resuscitation bag can be compressed, regardless of external circumstances. In doing so, the chance of hyperventilation caused by human error will be eliminated. Fabrication of the prototype demonstrated the ability to deliver the desired tidal volume of 15 mL (the target value for serving a 3kg neonate) at a precision of 87%. This level of precision is found to be adequate following the clinical recommendation of 4-6mL/kg. The proposed device, when fully developed, will offer an assisting guide to healthcare providers and ultimately reduce the overall risk of the resuscitation procedure, putting both the provider and the neonate patient at ease.

