According to Dr. Rozycki, our clinical sponsor, and other supporting literature, neonatal respiratory is about applying physiology. Therefore, a pressure system has to be put in place in order to breathe. When breathing, the diaphragm contracts creating thorax expansion which creates negative intrapleural lung pressure; the negative pressure causes a vacuum like behavior in the lungs that sucks the air in. Unfortunately, in premature infants, the diaphragm and other bones are flexible due to a lack of calcium. Thus the negative pressure is less in a premature infant because there is less pressure developing against the rigid diaphragm that creates the vacuum. Since the lung is not receiving an adequate amount of air during inhalation, there is a progressive loss of alveoli. This lack of alveoli results in a loss of surface area within the lung as well as stiffer lungs over time. If the lungs get stiffer, they are harder to expand which makes it harder to breathe. Furthermore, retractions start happening then oxygen levels along with carbon dioxide levels rise too high in the blood. Surfactant is currently given to the neonate to start the breathing process. However, a material is needed to improve the rigidity of the chest wall so that the neonates’ lungs can develop better. An increase in lung volume and chest wall rigidity in the premature baby would decrease the critical state of the baby and reverse the negative effects of a compliant chest wall on the lung. Therefore we propose a design for a material that noninvasively maintains ventilation of an extremely low birth weight premature infant by increasing the chest wall and its rigidity as well as the lung volume during the first few weeks of life.

As a result of this design concept, progress in the respiratory field could ensue. For example, the creation and implementation of a rigid chest wall support has the possibility of furthering research in lung capacity, respiration, and bone calcification studies. Common devices and methods are invasive and negatively affect infant respiration. Additional financial support for a non-invasive, less compliant device enhances the design team’s efforts.

In the same way, this project will positively impact the way we live because it will give neonatal babies a chance for better physiological development. Invasive ventilation negatively affects development by creating unrecoverable lung damage, increasing asthma, delaying speaking, causing sleep disorders, and promoting muscle weakness due to prolonged bedrest. However, with the application of this design concept the neonatal babies will be able to avoid most of the negative impacts associated with invasive ventilation. Another application of this product would be for professional sports, car accident victims, and the elderly population; in both situations the players and the patients receive physical damage to their rib cage and chest wall which makes it harder to breathe, by applying this design concept the players and patients will be able to breathe easier while their ribs are recovering. The elderly population experiences weakness and shortness of breath due to the decalcification of the chest wall. Therefore, this design concept will enable elderly people to breathe easier without being subjected to invasive ventilation methods. Overall, this design concept has potential to increase the quality of life for extremely low birthweight premature infants, injured sports professionals, car accident patients, and members of the elderly population.
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