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Short Commentary

Point on Early Neonatal Cardiovascular Changes and Hematocrit: Something to Study Further

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Introdution

Often the Hematocrit is a forgotten factor, it's correlation with other cardiovascular parameters is not considered or studied. The importance to considerate Hematocrit [1], during a research on a newborn, like a parameter of study is demonstrated by the laws of physics [2]. The most important law we consider is the Hagen-Poiseuille's law that shows the relationship between viscosity and hydraulic resistance:

$$R = \frac{8\eta d}{\pi r^4}$$

Where η is the viscosity, **d** the diameter of tube, **r** the radius of tube, **R** the resistance? Due to the small number of studies evaluating the impact of hematocrit on hydraulic resistance, in the different districts of circulation, until now we don't know the true weight of this parameter. The main districts in which more studies are needed are: cerebral, renal, cardiac, intestinal, pulmonary, and peripheral tissue/microcirculation.

Different studies found a reduction in resistance parameters such as RI (Resistance Index) in cerebral circulation (middle cerebral artery or anterior cerebral artery) during the first hours of life but rarely the correlation is analyzed with hematocrit reduction, typically marked in this postnatal period [3-5]. The renal circulation has a significative change during these hours too: is well assessed that there is a initial slow reduction of RI and augmentation of peak systolic velocity in renal arteries during the first days and than a more rapid change in these perfusion indexes [5]. The measurement of cardiac parameters during the transitional period let us to understand both the pulmonary and systemic circulation changes. Studies evidenced a better left cardiac function and a reduction of right ventricular pressure seen indirectly by significative change of pulmonary mean acceleration, pulmonary acceleration time and other parameters [2,3,6]. Another hot topic is the patent ductus arteriosus in very preterm newborns and the influence of hematocrit on it, a rise in hematocrit may have a positive influence causing a reduction of left-to right shunt derived from a different pressure gradient between systemic and pulmonary circulation. If this mechanism is demonstrated by large studies, could be useful especially in very preterm newborns in which the immature left ventricle is not able to support such high blood flow coming from the patent ductus arteriosus [7]. A big open window that still needs to be studied in newborn physiology is the change of viscosity/hematocrit in peripheral tissues and microcirculation. Starting from large to capillary vessels in case of a Newtonian fluid there is no change in viscosity and so the Hagen-Poiseuille's law is valid, but in vivo circulation there is another phenomenon that happens. The Fåhraeus-Lindqvist effect is a progressive decline in apparent viscosity when blood flows through glass capillary tubes of diminishing radius. This effect is mainly effective in the arteriolar segments of the systemic vascular tree, where the majority of the total peripheral resistance resides and is actively regulated. Thus, the Fåhraeus-Lindqvist effect has been suggested to be an evolutionary trait that alleviates the impact of arteriolar vasoconstriction upon total peripheral resistance and thereby maintain local tissue perfusion at a relatively lower blood pressure [8].

Conclusion

In conclusion, the systemic cardiovascular evaluation in relation to changes in hematocrit is an essential approach to study newborns, especially during the first days of life when the hematocrit shows a significant decrease. The knowledge of the main key points of cardiovascular regulation and the pharmacology to act on them are the milestone of neonatologist. Further studies will be useful to help physicians make evidence-based decisions particularly in the management of very preterm newborns.

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