The Norwood Procedure With Coronary Transfer to the Pulmonary Root: A Modification Proposed by Me or by God?

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In 2014, I was a third year resident in a cardiac surgery residency program pursuing my academic enrichment year. By that time, I had already read several publications confirming and discussing the suboptimal coronary perfusion after the Norwood procedure [1-5]. Thus, in my academic year I started to think of a new modification that could address this concern. I had the opportunity to attend the pathology museum and examine some specimens of hypoplastic left heart syndrome. The first idea that came to my mind was to incorporate the native hypoplastic aortic root with the amalgamation of the ascending aorta and pulmonary artery, creating a common arterial trunk with a common arterial valve. It sounded too complicated and unfeasible for me! One day, I was in the pathology museum examining a heart specimen after a Norwood procedure. I was focusing on the coronary buttons arising from very hypoplastic aortic sinuses and appreciating the amalgamation of the ascending aorta with the pulmonary artery being above the hypoplastic aortic root. The idea of coronary transfer to the pulmonary root immediately came to my mind.

As we know, the aortic sinuses have an important function in the normal physiology of coronary blood flow. In the modern era, surgical innovation requires extensive investigation and assessment before clinical implementation. The days when surgeons can experiment with new and unproven surgical techniques are gone. As such, given the advancements in the facilities and technologies we currently have, I strongly believe that we are in an era where “we should always simulate before we innovate.”

Computational fluid dynamics (CFD) and other advanced mathematical methods provide a unique and novel platform to test the feasibility and potential benefits or risks of surgical innovation. However, one must start with an identifiable and existing problem, for which we all recognize and understand the pathogenesis. Based on this, I decided to pursue a CFD study to evaluate the hemodynamic effect of our proposed modification compared to the original Norwood [6]. In the midst of our work, Saiki and colleagues from Japan published their study [7]. This study makes me more convinced of the necessity to address this problem, as it confirms the coronary malperfusion after the Norwood procedure even with the use of a Sano shunt.

While reviewing the literature to determine if this modification was ever proposed, I found an article published in the Journal of the American College of Cardiology in 1984 by Bharati and colleagues and entitled “Origin of Both Coronary Arteries From the Pulmonary Trunk Associated With Hypoplasia of the Aortic Tract Complex: A New Entity” [8]. Interestingly, the authors reported a baby who was born with hypoplastic left heart syndrome, with both of the coronary arteries arising from the pulmonary trunk. The patient was seen by a cardiac surgeon who considered the defect inoperable, and the patient died on the third hospital day. Although the defect had been deemed inoperable, the authors discussed the surgical options available at that time including the Norwood procedure, which had been very recently introduced when this child's heart defect was reported [9-10]. Had the Norwood procedure been performed in this patient, the main pulmonary trunk with the coronary arteries and the right ventricle would have been rendered the systemic circuit.

Honestly, I felt that I was proposing a modification that almighty God himself had already proposed 35 years ago, concomitant with the introduction of Dr Norwood’s procedure.

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