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EDITOR'S PAGE

The Future of the Fontan Circulation

A Call for Innovation and Collaboration

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In the realm of congenital heart disease, the Fontan approach remains a mainstay of palliative surgery for patients with single ventricle physiology. This life-saving procedure reroutes venous blood directly to the pulmonary arteries, bypassing the heart. Although it offers extended survival and improved quality of life compared with historical alternatives, the long-term challenges associated with Fontan circulation are daunting and multifaceted.[1]

CHALLENGES AND CONSEQUENCES

The problems inherent in Fontan circulation are significant. Patients can experience complications such as protein-losing enteropathy, plastic bronchitis, arrhythmias, liver fibrosis, and ultimately, heart failure.[2] These issues are compounded by the fact that the patient population is rapidly expanding because advancements in surgical techniques and multidisciplinary care paradigms have allowed more children with single ventricle physiology to survive into adulthood.[3] With increased survival, however, comes an urgent need to address the chronic and debilitating complications that arise over time.

The complexities of managing Fontan-associated problems necessitate a sophisticated and multifaceted approach. Merely treading water with current strategies is not enough; it is imperative that we strive for innovative solutions that can alleviate these burdens and enhance both the quantity and quality of life for these patients. We would like to encourage the community of clinicians caring for patients with congenital heart disease to continue to use *JACC: Case Reports* as a conduit for sharing experience and innovations in the care for this population.

HARNESSING THE POWER OF AI

The integration of artificial intelligence (AI) into medical practice offers a promising avenue for transformation. AI can assist in the early diagnosis and prediction of complications, personalize treatment plans, and optimize postsurgical outcomes through advanced data analytics and machine learning.[4] For instance, AI algorithms can analyze vast datasets to identify subtle patterns and correlations that may be undetectable by conventional statistical or quality improvement approaches, enabling more precise risk stratification and individualized management plans.

Furthermore, AI-powered decision support systems can aid clinicians in devising optimal interventional strategies tailored to each patient's unique physiology. The potential to predict outcomes and tailor interventions with unparalleled accuracy could revolutionize the standard of care for patients with Fontan circulation.

INNOVATIVE INTERVENTIONAL STRATEGIES

Interventional cardiology continues to evolve to meet the unique challenges posed by the Fontan circulation. Techniques such as lymphatic interventions and new stent technologies, paired with advanced imaging modalities, can offer less invasive and more effective solutions for managing complications.[5]

NOVEL THERAPEUTICS AND REGENERATIVE MEDICINE

Beyond interventional strategies, the development of novel therapeutics is crucial. Targeted pharmacologic treatments that address the specific pathophysiological processes involved in Fontan circulation could mitigate complications and improve functional capacity. Through subanalyses of the Fontan Udenafil Exercise Longitudinal trial data, we learned that there are differential responses to pulmonary vasodilator therapy—a keen reminder that one therapeutic

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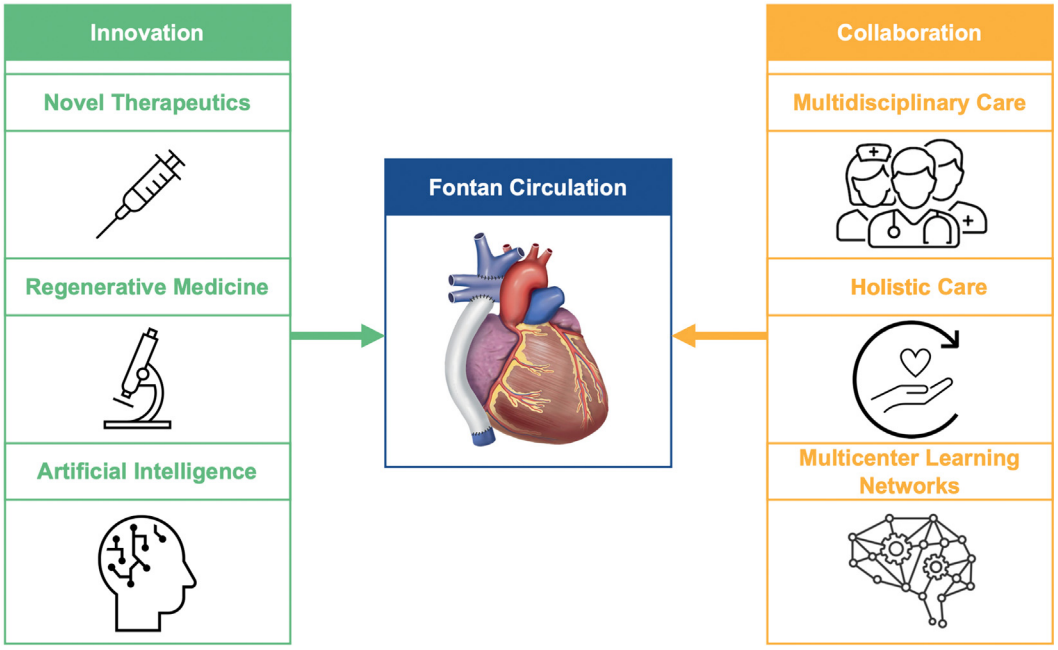
FIGURE 1 Future of Fontan Circulation: A Call for Innovation and Collaboration



approach does not fit for all patients.[6] Additionally, advancements in regenerative medicine hold the potential to repair or replace damaged tissues and organs, offering hope for more permanent solutions.[7]

HOLISTIC, MULTIDISCIPLINARY CARE

Optimal care for Fontan patients necessitates a holistic, multidisciplinary approach. Teams composed of cardiologists, hepatologists, pulmonologists, psychologists, and other specialists can address the complex and varied complications associated with Fontan circulation.[8] Comprehensive care models that include dietary support, tailored physical therapy regimens, mental health services, and regular monitoring hold promise to improve the overall well-being and quality of life for these patients.

MULTICENTER LEARNING NETWORKS AND DATA POOLING

The rarity of single ventricle congenital heart diseases necessitates collaboration across institutions to pool data and insights. Multicenter learning networks enable the aggregation of patient data from diverse populations, enhancing the statistical power and generalizability of research findings. These networks facilitate the identification of best practices, foster robust clinical trials, and accelerate the development of new treatment protocols.

Developing centralized databases and using standardized data collection procedures are crucial for advancing our understanding and management of Fontan-associated complications.[9] By sharing data and collaborating across centers, we can overcome the limitations imposed by rare disease research and drive meaningful advancements.

CONCLUSIONS

The future of Fontan circulation lies in our ability to innovate and collaborate effectively and share this knowledge seamlessly (Figure 1). By harnessing the power of AI, advancing interventional strategies, developing novel therapeutics, and fostering holistic, multidisciplinary care, we can turn the tide against the complications that beset this patient population. Furthermore, building and participating in

multicenter learning networks will amplify our efforts, ensuring that individuals with Fontan circulation not only survive but thrive in the years to come. Let us embark on this journey with determination, creativity, and a steadfast commitment to improving lives.

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