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Short Communication

Pediatric Cardiology: Advances in Congenital Heart Disease Treatment

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DESCRIPTION

Congenital Heart Disease (CHD) refers to structural abnormalities of the heart present at birth, impacting blood flow and heart function. Affecting nearly 1% of live births globally, CHD is a significant cause of infant morbidity and mortality. However, pediatric cardiology has witnessed remarkable advances in the diagnosis, treatment and management of CHD, transforming the prognosis for affected children. These advancements are in surgical techniques, interventional cardiology, diagnostic innovations and long-term care strategies leading to improved survival rates and quality of life [1].

Early and accurate diagnosis of CHD is essential for effective management. Significant progress has been made in prenatal diagnosis through fetal echocardiography. Advances in ultrasound technology enable detailed imaging of the fetal heart as early as the first trimester, allowing for the detection of complex heart defects. Additionally, the advent of 3-Dimensional (3D) echocardiography and Magnetic Resonance Imaging (MRI) has increased the accuracy of postnatal diagnosis. These technologies provide detailed visualization of cardiac structures, enabling precise assessment of defects and informing treatment strategies [2,3].

Genetic testing has also played an important role in CHD diagnosis. Chromosomal microarray analysis and next-generation sequencing have identified genetic mutations associated with CHD, improving the understanding of its etiology and facilitating early identification of at-risk pregnancies. These diagnostic tools allow timely intervention planning and parental counseling, significantly influencing outcomes. Complex cardiac surgeries that were high-risk now become routine due to the advances in surgical techniques and perioperative care. Neonatal and infant cardiac surgery have particularly benefited from innovations such as the Norwood procedure for hypoplastic left heart syndrome and the arterial switch operation for transposition of the great arteries. These procedures have significantly improved survival rates in neonates with critical CHD [4,5].

Minimally invasive surgical approaches, including robotic-assisted surgery and Video-Assisted Thoracoscopic Surgery (VATS), have reduced the need for large incisions, leading to shorter recovery times and reduced postoperative complications [6]. Additionally, advances in intraoperative imaging, such as real-time 3D echocardiography, have increased surgical precision, enabling more effective repair of complex defects. Catheter-based procedures, such as balloon valvuloplasty, device closure of atrial and ventricular septal defects and stent placement, have become standard treatments for many CHD cases. These procedures are typically performed in specialized catheterization laboratories and often result in shorter hospital stays, reduced pain and quicker recovery. One notable advancement is the development of Transcatheter Pulmonary Valve Replacement (TPVR), which allows for the replacement of dysfunctional pulmonary valves without open-heart surgery. TPVR has transformed the management of conditions, reducing the need for repeated surgeries and improving long-term outcomes [7,8].

Long-term care for children with CHD has improved significantly, thanks to advances in postoperative management and the establishment of specialized multidisciplinary care teams. Enhanced postoperative monitoring, including the use of Extracorporeal Membrane Oxygenation (ECMO) for critical cases, has improved survival during the immediate postoperative period. The focus on long-term follow-up has also grown, recognizing that many CHD patients require lifelong care. The transition from pediatric to Adult Congenital Heart Disease (ACHD) care is now an essential component of management, ensuring continuity of care as patient's age. Programs that provide comprehensive care, including regular cardiac monitoring, psychosocial support and lifestyle counseling, have become essential in improving quality of life and reducing long-term complications [9,10].

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