

Preferred Investigation techniques for congenital heart disease in India – A retrospective study

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Abstract:

Congenital heart disease is the most common birth defect globally. Management of this condition requires good imaging for the successful outcome. In addition to 2 Dimension echocardiography other advanced imaging modalities like 3 Dimension echocardiography, Computerized tomography scan (CT), Cardiac catheter study and Magnetic resonance imaging (MRI) are available.

We did a retrospective study on children presenting to the Paediatric cardiac center in terms of diagnosis and various investigations which not only aid to the diagnosis but also for successful outcome.

2 D echocardiogram still remains the basic and gold standard imaging investigation compared to other advanced imaging modalities.

Keywords: Congenital heart disease, echocardiography, CT angiogram, cardiac catheter study, MRI of heart

Introduction:

Congenital heart disease (CHD) is the most common birth defect with an incidence of 12-14 per 1000 live births. Imaging advances and surgical innovations has led to a increase in the population of CHD survivors. Defect complexity is a major determinant of overall health outcomes with survival to adulthood. Clinical diagnosis and identification of the defect is the most important initial step in the management and hence the role of cardiovascular imaging is crucial.

Incidence of congenital heart disease remains the same globally.¹ Today, clinical and echocardiographic diagnosis are good enough to provide accurate diagnosis but there still remain significant diagnostic problems that needs superior imaging for effective management.¹ The global survey of prevalence of congenital heart disease at birth, in 2017, is estimated to be nearly 1.8 cases per 100 live births, a 4.2% (95% UI 2.8–5.6) increase since 1990. In India ,the incidence and prevalence reflect the same.^{2,3} Acquired heart diseases incidence is also rising and myocarditis and dilated cardiomyopathy are

more prevalent than Rheumatic heart diseases in developing countries currently.⁴ The mortality rate has come down significantly because of the advances in diagnosis, intervention and prompt surgical management.²

The goals of diagnostic imaging in CHD are to identify anatomic and functional abnormalities, assess their severity, and provide information that warrants on clinical management. Knowledge of the anatomic features and feasible common interventions and their sequelae is vital in caring for patients with CHD. Transthoracic echocardiography is the most common imaging modality used in diagnosis and managing CHD patients. Other imaging modalities used are Transesophageal echocardiography, 3-Dimension echocardiography, Computed Tomography (CT) Angiography, Cardiac Magnetic resonance imaging (MRI), Nuclear scintigraphy and cardiac catheterization.

A rational multimodality approach individualized to each patient's clinical and safety profile is essential. Our present study aims to retrospectively inspect records of the children who had cardiac surgery in our institute and the imaging modalities used in managing the same.

Objectives of Study:

To analyze the medical records data of the imaging investigations done on children diagnosed with congenital heart disease.

Materials and Methods:

A Retrospective study was conducted in our tertiary care hospital. Imaging investigations done on Participants less than 18 years of age records who had undergone cardiac surgery for both congenital and acquired heart diseases at the institute from 01.01.2021 – 30.04.2021 were evaluated. There was a total of 63 surgeries performed during the time scale. We divided the children into three age groups for this study purpose.

Results:

Out of 63 patients included in our study 21 were male and 42 were female. Disease category: Of the total 63, 60 of them had congenital heart disease and 3 had acquired heart disease. The acquired were Dilated cardiomyopathy. All 63 had 2 D echocardiogram as a baseline investigation. Depending on individual conditions other imaging studies were used. Catheter study (cath) was performed in 10 patients mainly to assess pressures inside the heart especially for children undergoing 2nd or 3rd surgery. Computerized Tomography (CT scan) was performed in 17 children to clearly delineate the anatomy and Magnetic Resonance Imaging (MRI) was done in 3 children who had acquired heart diseases. (Table 1)

Table 1: Demographic details:

| Category | N = 63 | |
|----------|------------|----------|
| Age | < 1 year | 20 (32%) |
| | 1-5 years | 30 (47%) |
| | 5-15 years | 13 (21%) |

| | | |
|---------------------|--------|------------|
| Sex | Male | 21 (33.3%) |
| | Female | 42 (66.4%) |
| Investigations done | ECHO | 63 |
| | CT | 17 |
| | CATH | 10 |
| | MRI | 3 |

Table 2: Commonest Diagnosis in Different Age groups and Investigations performed other than Echocardiogram:

| Age group | Diagnosis | Frequency | Investigations | | |
|-------------|---|-----------|----------------|-----|-----|
| | | | Cath | CT | MRI |
| <1 Year | Transposition of Great Arteries (TGA) | 6 | Nil | Nil | Nil |
| | Total Anomalous Pulmonary Venous Drainage (TAPVD) | 4 | Nil | 1 | Nil |
| | Ventricular Septal defect | 7 | Nil | Nil | Nil |
| | Others | 3 | Nil | 1 | Nil |
| 1 - 5 Years | Ventricular Septal Defect | 5 | Nil | Nil | Nil |
| | Atrial Septal Defect | 7 | Nil | Nil | Nil |
| | Tetralogy of Fallot | 10 | Nil | 4 | Nil |
| | Others | 8 | Nil | 7 | Nil |
| 5-15 years | Dilated cardiomyopathy (Transplant) | 3 | 3 | Nil | 3 |
| | Univentricular repair | 7 | 6 | 3 | Nil |
| | Redo surgeries | 3 | 1 | 1 | Nil |

Discussion:

Though the incidence and prevalence of heart disease in children remain the same over years, morbidity and mortality of these children post-surgery have significantly come down due to advances in investigation and surgical techniques.² In our study group the most common congenital heart defect operated were ventricle septal defect, atrial septal defect in non-cyanotic children and Tetralogy of Fallot in cyanotic children. This correlates with the Indian data of congenital heart disease ⁵ In the age group of children less than 1 year the most common conditions are transposition of great arteries and total

anomalous pulmonary venous return and they present very early in the first few days of life. This data also reflects the global data on neonatal cardiac

surgery ⁶. Children less than 5 years are commonly referred group compared to their older peers. Congenital heart disease is still the predominant medical condition sent for referral and among the acquired, dilated cardiomyopathy dominates compared to Rheumatic heart diseases.⁴ Heart Transplantation outcome is satisfactory even in resource constrained environment of a developing country.⁷

2 D echocardiogram still dominates as a gold standard investigation for diagnosing and planning surgical and intervention management. Depending on individual cases other modes of imaging were performed which can determine the outcome.⁸ Computerized Tomography with angiogram were performed in patients who need to study more clear anatomy which was incomplete compared to 2 D echo. CT Angio accurately depict pre and post operative cardiac anatomy in exquisite detail.⁹ Of the children who had CT angiogram, the commonest condition who had it were pulmonary atresia to clearly delineate the anatomy of branch pulmonary arteries and collaterals. This anatomy is very important for surgical technique and its outcome. In these cohort CT with echocardiogram is better than MRI as they may have coils and stents.¹⁰

Cardiac catheter study was performed in children who need multiple surgeries and these were performed to assess the pressures inside the chambers and vessels in addition to clear anatomy. This pressure calculation is also important for successful outcome.¹¹ Although the utility of cardiac catheter study has been diminished it is still a valuable tool with echocardiography. ¹² In our study the majority of patients who had cardiac cath study were children going for 2nd or 3rd stage surgery for univentricular repair. The cath study in addition to echocardiography not only gives the anatomy but also the pressure calculations, vascular resistance which will dictate the outcome.

MRI which can give details on structure, flow and function were performed on children who were referred for dilated cardiomyopathy which dominates in the category of children with acquired heart diseases.¹³ MRI evaluation is considered as a valuable tool in addition to echo and cath study. MRI not only helps in assessing anatomy and flow it helps in identifying the etiology of cardiomyopathy.¹⁴In our study all the 3 children who had cardiac MRI had cardiac transplantation. MRI is being used regularly as an adjunct in investigations of cardiomyopathy who need cardiac transplant.¹⁵

Conclusion:

Congenital heart disease is still the predominant condition referred to the pediatric cardiology center. Acquired heart disease is a minority compared to congenital heart disease and we can see the rheumatic heart disease burden is coming down with better sanitation and hygiene. Children less than 5 years is the common age group and children less than 1 year also are getting referred which confirms the development of adoption of screening tests and clinical skills in the primary and secondary centers.¹⁶ 2 D echocardiogram still remains the basic and gold standard in diagnosis compared to other

imaging modalities^{8,17}, which are used on individual case basis that can improve the outcome. In comparison to other imaging techniques 2 D echo is non invasive with no side effects, no need of sedation / anaesthesia and radiation effect. However successful outcomes depend on the appropriate timing of referral, clinical skills of the multidisciplinary team of cardiologists, surgeons, perfusionists, anesthetists and intensivists.

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