

Pediatric tele-echocardiography in the diagnosis of congenital heart diseases in a regional referral hospital in eastern Bhutan

Purushotam Bhandari¹, Ruwan Morawakkorala²

¹Central Regional Referral Hospital, Gelephu, Bhutan

²Lady Ridgeway Children's Hospital, Colombo, Sri Lanka

ABSTRACT

Introduction: Congenital Heart Diseases are the commonest birth defects and the most common reason for out-country referral of pediatric patients in Bhutan. Without any qualified pediatric cardiologists in the country, early diagnosis and appropriate care of pediatric cardiac patients is often delayed or inappropriate. Collaboration through telemedicine between general pediatrician and pediatric cardiologist can improve the diagnosis of congenital heart diseases in Bhutan. **Methods:** Pediatric patients clinically suspected to have congenital heart diseases underwent Echocardiography at Mongar regional referral hospital. The Echocardiograms, performed by general pediatrician, were e-mailed to Pediatric Cardiologist working in UK, who gave the diagnosis after viewing the Echo-loops. This was compared with the final diagnosis made at tertiary cardiac centre in India. **Results:** 30 echocardiograms performed by general pediatrician at Mongar Hospital in eastern Bhutan were mailed to Pediatric Cardiologist working in UK. Of the thirty cases, 20 required no immediate referral and were put on medications and follow up plans. 10 of the 30 cases required early referral to tertiary care hospital in India. There was excellent concordance between the diagnosis made through tele-echocardiology and the final diagnosis made at tertiary cardiac centre. **Conclusions:** Tele-echocardiography between a general Pediatrician and a Pediatric Cardiologist can greatly enhance the diagnosis of congenital heart diseases in children.

Keywords: Monggar hospital; Pediatric cardiology; Tele-echocardiography; Telemedicine.

INTRODUCTION

Congenital heart diseases are the most common birth defects worldwide as well as in Bhutan¹. They are also the most common reason for out-country referral of pediatric patients from Bhutan to India². Diagnosis of congenital heart defects is largely delayed due to lack of specialists and echocardiography facilities. Bhutan has only two cardiologists and no Pediatric Cardiologist. Most patient requiring advance cardiac care are referred to the neighboring cities in India.

Mongar hospital sees a large number of pediatric cardiac patients every year of which congenital heart diseases make majority of pediatric cardiac patients³. The hospital is equipped with the latest Phillips iE33 cardiac ultrasound system but there no trained echocardiographer. During the Period of this study, pediatric echocardiograms were performed by general pediatrician with special interest in pediatric cardiology. Previously, all cases requiring echocardiography had to be referred to referral hospital in Thimphu, which is two days drive through difficult mountainous roads.

With the widespread reach of telecommunications and internet services, telemedicine can be a good answer for timely provision of specialist pediatric cardiac services in the far-flung hospitals⁴. This paper discusses the personnel experiences of the authors in using telemedicine in the field of pediatric

cardiology and establishes how tele-echocardiography can help in the diagnosis and management of congenital heart diseases in children without the need to travel to a center with pediatric cardiac services.

METHODS

From March 2009 to August 2011, pediatric patients underwent echocardiography at Mongar Hospital for various indications like cardiac murmur, cyanosis, respiratory distress in neonates, recurrent respiratory tract infections, failure to thrive and syndromic presentations. Cardiac murmur was the commonest indication.

An informed consent was taken from the parents in all cases before performing the echocardiogram. Standard sub-costal, para-sternal, apical and supra-sternal views were used to obtain standard images and cine loops. Two dimensional, M-Mode, Color Flow and Color Doppler studies were conducted in all the subjects. Those children with normal initial echocardiograms were reassured. Those children with mild lesions like small ASD, small VSD, and mild valvular lesions that were unlikely to require immediate attention were followed up.

The echocardiograms of 30 children who had more difficult or uncertain diagnosis, severe or complex lesions, were stored in the machine, transferred to a compatible disc and converted into short movies using the microsoft movie maker. Movies ranging from 1 to 5 megabytes were prepared and e-mailed, along with the clinical details of the patients, to the pediatric cardiologist working in UK through personnel contact. All the loops were seen and diagnosis suggested by the pediatric

Corresponding author:

Purushotam Bhandari
purub@druknet.bt

cardiologist. Where more detailed loops were required, the echocardiograms were repeated and resent. In most situations, diagnosis and management options was suggested via e-mail, whereas in more interesting and complicated cases, the authors discussed the cases through live videoconferencing using skype. Initial provisional diagnosis made by general pediatrician at Monggar Hospital was compared with the diagnosis made by the Pediatric Cardiologist colleague in UK. This was further compared with the final diagnosis made at tertiary cardiac centre in India.

RESULTS

Between March 2009 till August 2011, 500 pediatric Echocardiograms were performed. While majority of patients had normal echocardiograms or simple lesions like isolated small ASDs, VSDs or PDAs, 30 patients had cardiac lesions that were a diagnostic problem to the general pediatrician and required opinion of pediatric cardiologist.

These 30 echo loops were consulted with the pediatric cardiologist. A response was received in 100 percent of the cases either via e-mail or a video conferencing over skype. The diagnosis, management options and follow up plans were discussed in all cases. Of the 30 cases, pharmacotherapy and follow up plans were instituted in 20 cases and the remaining 10 patients were referred for further evaluation to India, where



Figure 1. Monggar hospital in eastern Bhutan

specialized pediatric cardiology and cardiothoracic services are available. These patients who were referred to India were followed up after their return to check on their final diagnosis at advanced cardiac centre.

As a result of tele-echocardiology between Monggar hospital in Bhutan and pediatric cardiologist in UK, it was possible to appropriately diagnose congenital heart diseases in Monggar hospital without physically referring the patient to another center. There was only 50 % agreement with the provisional diagnosis at Monggar hospital and the diagnosis made through tele-echocardiography. The diagnosis made through tele-echocardiography was found to be concurrent in 9 of the 10 cases (90 %) with the final diagnosis in a tertiary cardiac centre, as shown in Table 1 below

Table 1. Comparison of the diagnosis made at various levels

Sl No.	Age of child at presentation	Provisional diagnosis at Monggar hospital.	Diagnosis after consulting echo loops with pediatric cardiologist in UK.	Final Diagnosis at tertiary cardiac care centre in India
1	8 years	Massive right heart dilatation.	Ebstein's Anomaly	Ebstein's Anomaly
2	3 years	Large ASD	Large ASD	Large ostium secundum ASD
3	3 years	PDA	Large PDA	
4	5 years	Tetralogy of Fallot	Pulmonary Atresia, VSD	Pulmonary Atresia, VSD and Major Aortopulmonary collaterals.
5	5 years	ASD	Large ASD	Large ASD
6	8 years	Pink Fallot's	Pink Fallot's	VSD, PS, Sub aortic membrane
7	2 years	VSD, PDA	VSD, PDA	Situs Inversus, VSD, PDA
8	15 months	Tetralogy of Fallots	Tetralogy of Fallots	DORV, TGA, PS, VSD
9	4 years	Tetralogy of Fallots	Tetralogy of Fallots	Tetralogy of Fallots
10	4 months	Complex Cyanotic Heart Disease	Tricuspid atresia	Tricuspid atresia

ASD: Atrial Septal Defect; VSD: Ventricular Septal Defect, PDA: Patent Ductus Arteriosus; DORV: Double Outlet Right Ventricle; TGA: Transposition of the Great Vessels

DISCUSSION

In our study, we have demonstrated that collaboration between a general pediatrician and a pediatric cardiologist through telemedicine, can greatly improve the diagnosis of congenital heart diseases, plan appropriate management and arrange further referral of complicated cases. Further, the general pediatricians can improve their skills in echocardiography as a result of the tele-consultations and repeated feedback received from the pediatric cardiologist during the process of tele-consultation.

While congenital heart disorders are a major problem, pediatric cardiology is still an evolving specialty in most developing countries. In many countries, it is still managed by adult cardiologist, whereas in some adult and pediatric cardiac services are combined. In most developed countries, pediatric cardiology is an established sub-speciality with well organized diagnostic and interventional infrastructure and structured training programs.

In a resource poor country like Bhutan with limited tertiary care facilities, limited pediatricians and only two cardiologists in the whole country, reaching cardiology services to the entire country will be a difficult task. Late diagnosis sometimes makes further management difficult as many operable lesions become in-operable. Further, recurrent infections, growth failure and chronic ill health make many children unfit for surgery at the time of diagnosis.

Telemedicine is an effective alternative especially in rural areas⁵. With innovative technologies today, it is possible to take many specialized services to the rural masses. In the field of cardiology, tele-ECG is an established practice in many places. Portable cardiac ultrasound systems like laptop size and hand held echocardiography machines can become excellent tools to screen patients in the rural and far flung places⁶. Collaboration between rural hospitals and specialized centers with the optimal use of telemedicine can make a huge difference in the diagnosis, management and follow up of patients⁷.

In the our experience, basic knowledge of echocardiography, the skills to obtain and record standard images and the availability of a second opinion center, can make huge difference in the timely diagnosis, appropriate management and referral of children with congenital heart diseases. Computer and internet facilities at the work place, adequate time, dedication, interest in the subject and a consistent and accommodating specialist at the other end, are vital for the successful practice of tele-echocardiography. This example of tele-consultation at personnel level has the scope of replication at institutional level for a wider use telemedicine and tele-cardiology in developing countries.

CONCLUSIONS

Basic knowledge of echocardiography in general pediatricians along with facilities to save and export images and loops and the subsequent tele-consultation with a specialist colleague working

elsewhere, can greatly enhance the diagnosis, management and follow up of congenital heart diseases in a resource poor setting with no access to Pediatric Cardiology Services. There is an excellent agreement between the diagnosis made by Tele-echocardiography and the final diagnosis made at a tertiary cardiac centre.

ACKNOWLEDGEMENTS

Authors would like to thank all the staffs of Department of Padiatrics, ERRH, Mongar.

REFERENCES

1. Christianson A, Howson C. Bernadette Modell. March of dimes global report on birth defects. New York: March of dimes birth defects foundation; 2006. [\[Full Text\]](#)
2. Jigme Dorji Wangchuk National Referral Hospital (JDWNRH). Out-country Referral Records 2008-2009. Thimphu: JDWNRH; 2009. [\[Full Text\]](#)
3. Monggar regional referral hospital. Indoor admission register 2008-2009. Monggar: Monggar regional referral hospital; 2009. [\[Full Text\]](#)
4. Sable CA, Cummings SD, Pearson GD, Schratz LM, Cross RC, Quivers ES, Rudra H, Martin GR. Impact of telemedicine on the practice of pediatric cardiology in community hospitals: Pediatrics. 2002 Jan;109(1):e3. [\[PubMed | Full Text | DOI\]](#)
5. Sekar P, Vilvanathan V. Telecardiology: effective means of delivering cardiac care to rural children: Internet. San Antonio: UT health Sceince Center; 2009 Jan (updated 2015 27; cited 2009 Mar 1). [\[PubMed | Full Text | DOI\]](#)
6. Otto CM. The Practice of Clinical Echocardiography. 3rd ed. Philadelphia, PA 19103-2899: Saunders Elsevier; 2007. [\[Full Text\]](#)
7. Widmer S, Ghisla R, Ramelli GP, Taminelli F, Widmer B, Caoduro L, et al. Tele-echocardiography in Paediatrics. 2003 Apr;162(4):271-5. [\[Full Text | DOI\]](#)