

A Model for Screening School Children for Congenital Heart Disease in Developing Countries

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Introduction

Early detection of congenital heart disease is essential to preventing degeneration of the pulmonary vasculature, chronic damage to the cardiac chambers, and/or early death (see Figure 1). In developed nations, infants are examined at birth as well as periodically throughout early childhood. At the first sign of pathologic murmur or other signs or symptoms, ultrasound exams are performed to either diagnose or exclude cardiac birth defects. However, in many developing countries, medical personnel are insufficiently aware or trained to perform routine stethoscopic examinations. We of the China California Heart Watch (www.chinacal.org) suggest here a model for mass stethoscope screening of children for congenital heart disease that could be applied throughout the developing world.



Figure 1. CT and echo frames of a 16 yr. old boy's heart. Arrow shows stenotic mitral valve. There is also an ASD. Right atrium and ventricle are severely dilated due to long-standing undiagnosed and untreated heart disease.

Background

In rural Yunnan Province, China, primary caregivers are not yet sufficiently educated to screen all newborns and young children regularly. Primary caregivers in rural Yunnan are typically village doctors, who undergo a few months to two years of training after graduation from high school. Furthermore, most of their training focuses on infectious diseases, which are still a major source of illness and disability.

In 2005, Jiang et al¹ reported the results of a survey of classroom children in rural Yunnan province. In a single day, the team of cardiologists working with Dr. Jiang trained local village doctors to recognize heart murmurs. These village doctors then stethoscope-screened 48,638 children between the ages of 3 and 18. Children with heart murmurs underwent full examinations by cardiologists, including cardiac ultrasound. Using this method, Dr. Jiang found a prevalence of congenital heart disease ranging from 2.75 to 17 per thousand children in various counties, which is similar to that found in developed nations. What is most telling is that the majority of children diagnosed did not previously know that they had heart disease. Equally interesting, the team reported that most screening personnel (in large part village doctors) were unaware of the proper use of a stethoscope before the training. In short, using screeners who were trained in one day to recognize heart murmurs, Dr. Jiang's team was able to detect the same prevalence of pediatric heart disease as that reported in developed nations where pediatric screeners undergo extensive practical training during medical school, internship and pediatric residency.

Methods

After discussing the methods and results of her study with us, Dr. Jiang inspired us to begin a similar screening program in Yunnan province using both Chinese and foreign undergraduate and medical students as screeners. Our training and screening procedure is as follows:

1. A group of between three and 12 undergraduate and medical student volunteers undergo one half-day of training, divided into two parts: proper use of a simple diaphragm stethoscope and recognition of heart murmurs using electronically recorded murmurs from children and adults. Emphasis is placed on sensitivity (detecting any murmur or abnormally split second sound), rather than on specificity (distinguishing physiologic from pathologic murmurs). Students are tested at the end of the training with ten recordings, three of which are normal. If a student incorrectly reports an abnormality as normal, he/she must repeat the training.
2. After training, students are brought to a local hospital, where they must auscultate the hearts of three or four pediatric or adult patients with heart disease and abnormal auscultatory findings.
3. Students travel with one to three cardiologists to impoverished rural towns where they live and work for 10 to 25 days.
4. Each day, a team of students under the supervision of a cardiologist (one cardiologist to four students) screens classroom children for several hours. Two screeners work in the front of each classroom as the children march up, lift their upper garments and undergo auscultation at four auscultation points.
5. Any child with a heart murmur is referred to a supervising cardiologist. If the cardiologist deems the murmur to be pathologic, he/she with the help of students and nurses perform full exams, including history, physical exam, pulse oximetry, and cardiac ultrasound.
6. Families are notified and referrals are made if appropriate.



Figure 2. Students stethoscope screen classroom children.



Figure 3. Schoolchildren wait to be screened.



Figure 4. US medical student takes history from family of child with heart disease

When the family can produce documentation of poverty (income less than \$1,500 per year), an offer of financial assistance is arranged.

Results

Since starting the program in March 2009, we have screened about 17,000 children between the ages of four and 16 and detected 78 cases of congenital heart disease (4.6 per thousand). Approximately half of these cases were not previously diagnosed, or the children's families only vaguely remembered being told that the child had congenital heart disease. Only about one fifth had previously undergone corrective procedures. We referred about 25 of these children for corrective procedures and have reported on some of the results elsewhere.² In most of these referred cases, we assisted families with financial support for surgical and non-surgical procedures. Three cases of complex disease were deemed inoperable, in part due to late diagnosis (two double outlet right ventricles and one large VSD with pulmonary hypertension).

Discussion

Based on Dr. Jiang's experience and our own, effective screening of congenital heart disease can be carried out in a developing country using personnel with little prior training in the use of a stethoscope. We have some concerns but the fact that both Dr. Jiang's program and our own achieved a detection rate close to that in developed nations suggests that sufficient sensitivity in a clinical environment where many children with heart disease would not have been diagnosed at all, had we not intervened.

One concern is related to the detection of atrial septal defects (ASD), that are often missed, even in developed nations. The fixed split of the second sound and the low intensity pulmonic flow murmur of an ASD are difficult to detect even for trained pediatricians. Coarctation of the aorta is

another less common defect which can be missed in classroom screenings. However, until the primary caregivers are regularly examining the cardiovascular systems of all children, this method has much to offer to impoverished communities in developing countries.

Another potential drawback is the lack of family and/or community resources needed to treat certain cases of heart disease. This problem is gradually being resolved in rural China with the enactment of new health insurance laws and the activities of large charitable foundations like the Red Cross and the Hua Xia Foundation. However, in some developing nations, awareness of the presence of heart disease is less relevant, due to the lack of treatment funds and resources. We believe that it is much better to know that a problem exists and must be addressed, rather than to ignore it. Knowledge is the first step to a solution. Therefore, we encourage government and non-government groups in all developing nations to consider this approach to screening.

Conclusion

Training local medical, para medical and even non medical personnel in classroom screening of children for congenital heart disease is an option that can detect thousands of cases and save thousands of lives. National health department and the World Health Organization should consider this approach in all developing nations where primary caregivers are not full trained to carefully examine well children.

The international community has appropriately responded with volunteer assistance and funds to address the problem of treating known cases of pediatric heart disease in developing nations. The China California Heart Watch (www.chinacal.org) suggests that similar energy be expended in addressing the problem of early detection using massive classroom screening programs. Thousands of children's lives can

be prolonged and much suffering alleviated by applying this simple and inexpensive approach.

1. Jiang LH, Duan CQ, Ma ZQ, et al. [Epidemiological investigation on congenital heart disease in several regions of Yunnan province]. *Zhonghua Liu Xing Bing Xue Za Zhi*. Mar 2005;26 (3):182-186.
2. Ho T, Ouyang H, Lu Y, Hu Young A, Chintala K, Detrano RC. Post Procedure Outcomes of Rural Children Undergoing Correction of Congenital Heart Lesions in Yunnan Province China. *Pediatric Cardiology* January, 2011.

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