ORIGINAL ARTICLE

Managed Care Network for the assessment of cardiac problems in children in a district general hospital: a working model

K Pushparajah, D Garvie, A Hickey, S A Qureshi

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See end of article for authors' affiliations

Correspondence to:
Dr S A Qureshi, Evelina
Children's Hospital,
Department of Congenital
Heart Disease, Lambeth
Palace Road, London SE7
7EH, UK; Shakeel.
Qureshi@gstt.nhs.uk

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Aim: To assess a model for cardiology assessments in children with suspected heart disease by a general paediatrician with special expertise in paediatric cardiology (PsePC) in a district general hospital.

Methods: A new monthly "screening" clinic was established in May 2004 by the PsePC to reduce the burden of new referrals on outreach tertiary paediatric cardiology services. All patients were to have echocardiograms as part of their referral for cardiac assessment. Over a one year period (May 2004–April 2005), through audit, details of referrers, indications for referral, echocardiography assessments, and subsequent management were recorded. This was compared with the pattern of patients seen in the joint paediatric cardiology outreach clinics over a two year period (May 2003–April 2005).

Results: In the "screening" clinic, there were 75 appointments for 65 patients seen in 12 months. Fifty five of these patients had normal echocardiographic studies. Of the 47 referrals with heart murmurs in asymptomatic children, four had structurally abnormal hearts on echocardiographic assessment. Between May–October 2003 and November 2003–April 2004, the number of new patients with normal echocardiographic studies seen in the paediatric cardiology outreach clinic was 33/106 (31%) and 28/110 (25.4%) respectively. Following the introduction of the "screening" clinic, the number decreased to 21/99 (21%) during May–October 2004, and 10/102 (9.8%) during November 2004–April 2005.

Conclusion: This model can work effectively in order to identify pathology requiring input of a paediatric cardiologist more appropriately. Paediatricians with specific training in paediatric cardiology are potentially well equipped to provide this basic screening service.

There has been a marked increase in the demand for paediatric cardiology services over recent years with reported increased workload of up to 51% over the five years between 1989 and 1994.¹ Furthermore, there has been an increase in the number of children with asymptomatic murmurs needing evaluation by echocardiography, which was subsequently found to be normal.^{1–2} This is in part due to the increased detection of murmurs by general practitioners and paediatricians and in part to a greater parental awareness of echocardiographic assessment and the need for reassurance of cardiac normality.

The change in workload has been reflected in the increased need for attendance at outreach clinics by paediatric cardiologists. Wagstaff *et al*³ reported a 61% increase in the number of outpatient clinics over a five year period. Such an increase in the workload removes paediatric cardiologists from tertiary centres and therefore has an important impact on clinical care, and teaching and research activities at the tertiary centres.

The role of a general paediatrician with special expertise in paediatric cardiology (PsePC) has grown extremely slowly, with local paediatricians developing skills in echocardiography under the supervision of visiting paediatric cardiologists. This is particularly the case with neonatologists, who increasingly perform echocardiography on neonatal units with good results.^{4–5} This leaves the question of defining the exact role of the PsePC within the setting of a district general hospital.

In our district general hospital, monthly joint paediatric cardiology outreach clinics have been held, in which an average of 18 patients are seen in each whole-day clinic. Some of these clinics were half-day sessions, as the visiting cardiologist also ran a joint adult congenital heart disease

clinic in our hospital, which was not included in our study. The hospital has had an established system of a PsePC working with a paediatric cardiologist for over 12 years. However, there was a continuing increase in the demand for new and follow up patient slots in these clinics. In response to this demand, the paediatric cardiologist proposed the establishment of a separate monthly "screening" clinic in which children could be evaluated by a PsePC. The patients for such a clinic would consist of those with asymptomatic murmurs or medical complaints with possible but not definite cardiac diagnoses, who were referred by general practitioners (GPs) and paediatricians. All GP referrals were first seen by paediatricians before referral to our clinic. The indications for echocardiographic assessment are based on the level of confidence of the referring paediatricians to exclude cardiac pathology.

The paediatrician involved in this clinic had trained in echocardiography under the regular supervision of the paediatric cardiologist prior to setting up this model. The training involved a minimum of 200 echocardiograms performed annually under the direct supervision of the cardiologist in monthly joint clinics. In the "screening" clinic, echocardiography was performed by the PsePC and a paediatric cardiologist subsequently reviewed all the echocardiograms. This practice was maintained to provide quality assurance in our service and continues to be in place.

We report our experience of the "screening" clinic over a one year period. We have analysed the activity and the profile of the joint paediatric cardiology clinics prior to the start of the new "screening" clinic and the subsequent impact of the new clinic on the activity and profile of the joint paediatric cardiology clinics.

Table 1 Reasons for referral

Reason for referral	Number of patients
Asymptomatic heart murmur	47
Asymptomatic heart murmur + family history	3
Follow up of known abnormality	Kawasaki 1
Neonatal follow up	VSD 2
	PDA 1
	PFO 1
Screening for cardiomyopathy	2
Screening associated anomaly (including trisomies)	2
Palpitations	1
Chest pain	2
Drop attacks	1
Antenatal arrhythmia	1
Total	64

VSD, ventricular septal defect; PDA, patent ductus arteriosus; PFO, patent foramen ovale.

METHODS

A "screening" clinic was established in our district general hospital in May 2004. All referrals for paediatric cardiology assessment, made by consultant paediatricians working in the hospital or community, were screened by the PsePC for attendance at the "screening" clinic or the monthly joint paediatric cardiology clinic. Information was collated for all the monthly "screening" clinics over a one year period between May 2004 and April 2005. The basic details of the patients were recorded, including details of the referrer and the indications for the referral. These were then correlated with the echocardiographic findings and the subsequent management. We then compared the data with the pattern of patients seen in the normal joint paediatric cardiology outreach clinic over a two year period from May 2003 to April 2005.

RESULTS

A total of 75 appointments were made for 65 patients for the "screening" clinic over the 12 month period, an average of 6.2 new patients per clinic. There were 10 non-attenders: six did not attend, and the remaining four cancelled and rebooked their appointments. A total of 64 echocardiograms were performed on the 65 patients, because one patient was too distressed for echocardiography and had to be rebooked. The reasons for referral for these patients are outlined in table 1.

Table 2 outlines the echocardiographic findings from the "screening" clinic. Of the 47 referrals for asymptomatic murmurs, 43 (91.5%) were found to have structurally normal hearts on echocardiographic assessment. However, 4 (8.5%) had structurally abnormal hearts, which included 1 patient with a ventricular septal defect, 1 with mild aortic stenosis, and 2 with pulmonary stenosis, the severity of which was mild in one and moderate in one. Two of these four

abnormalities detected were assessed by the referring clinician as likely to be pathological. The diagnoses were confirmed in all of the patients on review of the videotape recordings by the paediatric cardiologist, taking up about 15 minutes of their time per "screening clinic".

Profile of joint cardiology clinics

Figure 1 illustrates the distribution of patients with normal echocardiograms in each paediatric cardiology outreach clinic within each six month period. Between the two six-month periods of May–October 2003 and November 2003–April 2004, 33/106 (31%) and 28/110 (25.4%) patients seen in the joint paediatric cardiology clinic had normal echocardiograms having been referred as new patients for cardiac assessment. Subsequently, after the introduction of the "screening" clinic in May 2004, this figure decreased to 21/78 (21%) patients between May and October 2004. However, in the period November 2004–April 2005, this figure reduced further to 10/102 (9.8%). This is likely to reflect the lag period in new clinic appointment allocation prior to the murmur clinic being set up. There continued to be a proportion of normal hearts in the follow up group due to spontaneous resolution of some congenital lesions such as patent ductus arteriosus, patent foramen ovale, and ventricular septal defects in these patients.

DISCUSSION

The provision of paediatric cardiology services in a hub and spoke configuration is widely accepted. How this service is provided to the patients at the outreach district general hospitals is very variable. The concept of outreach clinics is commonplace, but there is no established ideal model of care. The type of clinics varies from those run by a paediatric cardiologist working alone, a paediatric cardiologist helped by an echocardiographer,⁶ or a paediatric cardiologist working with a paediatrician with an interest in paediatric cardiology (PsePC). However, these outreach clinics should ensure efficient use of the time of the paediatric cardiologist, while continuing to provide good quality care.

Most of the current models of provision of services have not addressed the changing needs of the patients and the impact on the tertiary services. The traditional method of outreach clinics may have taken the specialist service to the patients locally, but it has been at the expense of taking the paediatric cardiologist away from the tertiary unit. Almost every paediatric cardiologist in the United Kingdom is likely to be away from the tertiary unit on average about one day per week. This has a knock-on effect on the care of the patients in the tertiary units. The uncontrolled referral pattern has resulted in long delays in patients being seen in the outreach clinics. In addition, when the number of referrals of patients subsequently found to have structurally normal hearts is taken into consideration (around 28% of the

Table 2 Echocardiographic findings from the "screening" clinic

ECHO findings	Diagnosis	Number	Discharged	Cardiac clinic referral
Normal heart	Normal	55	55	2
	History of cardiomyopathy	2		
Structurally abnormal heart	VSD (apical)	3 (1 new diagnosis)	55	3
	Pulmonary stenosis	2		2
	Aortic stenosis	1		1
	Dilated coronary arteries with Kawasaki disease	1		1
Total ECHOs		64	55	9

patients in our joint paediatric cardiology clinics), the role of the paediatric cardiologist has to be questioned.

The patient groups needing to be seen in most outreach paediatric cardiology clinics continue to increase with a changing emphasis towards screening. There is a greater awareness of cardiac causes of sudden death in adults. These include cardiomyopathy and long QT syndromes. More mothers with a family history of congenital heart disease are being screened antenatally, with many newborns from these pregnancies requiring follow up postnatally. A vast majority of patients with a congenital or chromosomal abnormality now have a screening echocardiogram as part of their diagnostic assessment. Patients diagnosed with a structural defect then need to be followed up in the long term whether or not they have surgery, although some with minor heart disease may be discharged. Acquired conditions including Kawasaki's disease and cardiomyopathy need more urgent review. A significant workload is generated further by patients presenting to the general paediatrician with worrying symptoms, which may or indeed may not be of cardiac origin. These include palpitations, chest pain, syncope, and "funny turns". The likelihood of these patients having significant cardiac disease is minimal. Nevertheless, some of these patients need to be seen for reassurance. Thus it can be seen that the workload undertaken in the outreach clinics by paediatric cardiologists from the tertiary centres is continuing to increase without necessarily an increase in manpower support.

The challenge to the currently over-stretched paediatric cardiology services is to provide a comprehensive service to this increasing population in the safest way locally. We suggest that our pattern of working is an efficient use of resources, which can be emulated in other networks.

The prevalence of pathologic disease in patients who are asymptomatic is estimated at about 2%. However, this estimate is dependent on the methods used to detect and diagnose the pathology and could be higher.⁷ Detection of an underlying structural abnormality of the heart can prevent serious complications, by allowing appropriate interventions and advice about prophylaxis against endocarditis. It is recognised that the sensitivity and specificity of clinical examination alone by paediatricians, in screening for pathological cardiac lesions is variable.⁸⁻¹⁰ It may be suboptimal in the American experience among office based paediatricians.⁸ There is no comparative published data assessing UK based general paediatricians. The diagnostic accuracy of echocardiography is also operator dependent. Some argue that the diagnostic accuracy in the hands of non-cardiologists is poor.¹¹ In our model, all the echocardiograms

Figure 1 Proportion of normal ECHOs (as new referrals) among total outreach clinic patients.

What is already known on this topic

- There is an increase in the demand for cardiological assessments in patients with normal hearts.
- Paediatricians have anecdotally been able to acquire skills on neonatal units to provide a service traditionally provided by visiting paediatric cardiologists.

What this study adds

- Paediatricians can provide cardiological assessments which include echocardiography in a general paediatric setting without a reduction in diagnostic accuracy.
- A working model is proposed, that incorporates a high degree of quality assurance into the role of PsePCs in a district general hospital.

were reviewed subsequently by the paediatric cardiologist, hence introducing a level of quality assurance.

Our model relies on the paediatrician being trained adequately in paediatric echocardiography. While previously such training may have been patchy, now there is a slow increase in training posts specifically designed to produce a PsePC. Appointment of such paediatricians would need to be linked to the tertiary centres for educational and continuous professional development. This trend has already started. Already there is a curriculum that has been agreed between the JCHMT (Joint Committee on Higher Medical Training) and RCPCH (Royal College of Paediatrics and Child Health) for this training and therefore it should be possible to train an adequate number of PsePCs.

Our model has helped to rationalise the paediatric cardiology services. It has reduced the number of patients with structurally normal hearts from about 31% to 9.8%, thus allowing the more needy patients to be fitted into the paediatric cardiology clinics. Furthermore, the waiting times for appointments for these clinics have been reduced. Patients who have had cardiac surgery at the tertiary centre and who need close follow up can now be easily fitted into these clinics without heavy overbooking. Thus, the PsePC has a role in overseeing management and providing continuity of care for cardiac patients and their families in the context of centralised tertiary cardiac services.

While it may be unrealistic to expect a PsePC at every outreach hospital, it may be possible to rationalise these services by the development of a sub-regional paediatric cardiology centres in some outreach hospitals, which then offer the service to other district general hospitals in the vicinity.

Conclusion

Paediatricians with specific training in paediatric cardiology are potentially well equipped to provide a basic screening service, combining clinical assessment with echocardiography, within a supported network.

Authors' affiliations

K Pushparajah, D Garvie, A Hickey, Department of Paediatrics, University Hospital Lewisham, London, UK

S A Qureshi, Department of Congenital Heart Disease, Guy's and St Thomas' Hospitals Foundation Trust, London, UK

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IMAGES IN PAEDIATRICS

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Giant cerebral arteriovenous malformation

A 3-year-old girl presented with a 12 hour history of left sided weakness. The parents reported that she had experienced episodic partial amnesia in the preceding weeks, being unable to recognise her favourite cartoon characters and family friends.

The examination revealed reduced power in the left upper and lower limb (4/5) and unsteady gait, without other neurological abnormalities. Prominent dilated, pulsating veins in the right parietal region and a audible bruit in the same area were noted on examination (fig 1). A cranial MRI (fig 2) scan showed a large, dysplastic arteriovenous malformation with moyamoya-like appearance extending throughout most of the right hemisphere and crossing the midline. An angiogram (fig 3) confirmed shunting between this malformation and the extracranial circulation.

The patient recovered fully from this episode but continues to experience transient ischaemic attacks with varying symptoms including amnesia, mood swings, motor deficits, and visual impairment. The treatment options are limited by her young age and the extent of the malformation. Since interventional endovascular closure is deemed to be technically unfeasible, alternatives including microsurgery and radiosurgery are currently being considered.

Arteriovenous malformations are congenital disorders with an estimated prevalence of 0.68 per 100 000.¹ Data from postmortem examinations suggest that as few as 12% become symptomatic during life.² Although the majority of cases present before 40 years of life, symptomatic manifestation this young is extremely rare. Intracranial haemorrhage

Figure 1 Clinical photograph showing prominent scalp veins. Consent was obtained for publication of this figure.

Figure 2 Initial MRI scan showing an extensive vascular malformation in the right hemisphere.

is the most common presenting feature, followed by seizures, recurrent headaches, and progressive neurological deficit.³ Heart failure, macrocephaly, and prominent scalp veins are less commonly seen in this group of patients.

M O Tebruegge, A Shrivastava

Department of Paediatrics, Southend University Hospital NHS Trust, Westcliff-on-Sea, UK

Correspondence to: Dr M O Tebruegge, Department of Paediatrics, Southend University Hospital NHS Trust, Prittlewell Chase, Westcliff-on-Sea, SSO 0RY, UK; marc.tebruegge@southend.nhs.uk

Competing interests: None declared.

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Figure 3 Angiogram showing the dysplastic character of the arteriovenous malformation. Further sequences showed shunting between intra- and extracerebral circulation.