Editorial

Isolated left ventricular non-compaction: a distinct cardiomyopathy?

Isolated left ventricular non-compaction (IVNC) was first described just over a decade ago,[1] and is now gaining prominence as a rare, but important, differential in the diagnosis of patients presenting with cardiac failure. This unclassified cardiomyopathy, previously known as "spongy left ventricular myocardium", is characterised by prominent myocardial trabeculations and deep intertrabecular recesses which lie in continuity with the left ventricular cavity. Although prominent trabeculae are seen in the normal right ventricle, the persistence of prominent left ventricular trabeculation is not normally apparent after birth. This failure in the normal compaction of the ventricular endomyocardium results from an arrest in cardiac embryogenesis (fig 1).

Many cases of left ventricular non-compaction are caused by associated anomalies that generate intraventricular pressure overload, as for example in pulmonary atresia with intact ventricular septum[2] or anomalous origin of the left coronary artery from the pulmonary trunk.[3] In these hearts, the deep recesses are in continuity with the ventricular cavity and with the coronary arteries and are therefore more accurately described as persistent intramyocardial sinusoids. In contrast, IVNC has no associated cardiac lesions and persistent sinusoids are not seen. Furthermore, the genetic basis for isolated IVNC is now becoming established and both x-linked[4] and an autosomal inheritance is seen.

Clinical course

Non-compaction of the ventricular endocardium primarily affects the left ventricle, but may also involve the right ventricle although distinguishing this from normal anatomy is more difficult. Patients present with both systolic and diastolic dysfunction, cardiac arrhythmias, and embolic events.[5] Discriminating IVNC from other causes of cardiac failure is not easy, often because of a lack of awareness of the condition. Indeed, in a review of adult patients with identified IVNC, Ritter and colleagues found that the mean (SD) time from symptom onset to diagnosis was 3.5 (5.7) years[6]

To date many of the published reports on this disorder have examined a predominantly paediatric population.[1 7 8] However, it is now apparent that left ventricular non-compaction may present in adulthood,[6 9] mainly as a result of symptoms of heart failure.

Mass screening has provided information on the natural history of patients with IVNC who are asymptomatic at presentation. In a Japanese paediatric population, it was found that left ventricular dysfunction developed over a longer time course, with restrictive physiology dominating the early stages of the disease.[8] In contrast to the reported cases in symptomatic adults, ventricular arrhythmias and embolic events were rare.

Diagnostic criteria

Many patients present following a routine echo in which an "uncertain" appearance is noted. Because of the rarity of this condition and the relatively recent description, the diagnosis is often overlooked and many cases are probably left undiagnosed or labelled as an echo oddity. Added to this is the fact that non-compaction (that is, prominent trabeculation) is most pronounced at the left ventricular apex, which to date has been a particularly difficult segment of the heart to visualise at echo. However, the advent of enhanced endomyocardial definition with the newer generation echo machines should in large part overcome this problem, and indeed it is likely that the greater recognition of IVNC in recent years is in part due to this.

In the symptomatic patient, differentiating IVNC from other cardiomyopathies may also prove problematic, with many cases of dilated cardiomyopathy being revised to that of IVNC at postmortem examination. As IVNC differs significantly from dilated cardiomyopathy both in terms of the genetics and the natural history, it is important to distinguish between IVNC and other causes of dilated cardiomyopathy.

In this issue of *Heart*, Jenni and colleagues have attempted to promote a greater understanding of IVNC, both in terms of diagnostic echo criteria and in terms of establishing isolated IVNC as a distinct cardiomyopathy.[10] They have correlated the echo and pathological findings and as a result provided distinct diagnostic echo criteria. The results show that in the absence of any coexisting cardiac anomaly, the echo findings of a two layered structure (in which the non-compacted layer at end systole is at least twice as thick as the epicardial band) in association with colour Doppler evidence of perfused intertrabecular recesses, are diagnostic of isolated IVNC. Not only will this information allow the diagnosis (during life) to be made with greater confidence, but it makes a strong case for considering isolated IVNC as a distinct disease. With the genetics of this condition now becoming available, the case for isolated IVNC as a distinct cardiomyopathy appears overwhelming.

Interestingly, Jenni and colleagues found that the process of non-compaction was predominantly localised to the lateral, inferior, and apical walls, but that the wall motion abnormalities were not confined to these areas.[10] This segmental appearance is an important feature as prominent trabeculae may also be seen in hypertrophied hearts. In these cases, however, the trabeculation is diffuse, and moreover the ratio of non-compacted to compacted layer is < 2.

Screening for IVNC

The identification by Jenni and colleagues of diagnostic echo criteria for isolated IVNC is an important step forward and will now allow for family screening of first degree relatives of affected individuals. Preliminary data suggest that although patients with IVNC who are asymptomatic at presentation have a longer clinical course, the majority of these individuals do go on to develop left ventricular dysfunction.[8] In addition, adult patients are at risk of ventricular arrhythmias and systemic emboli even

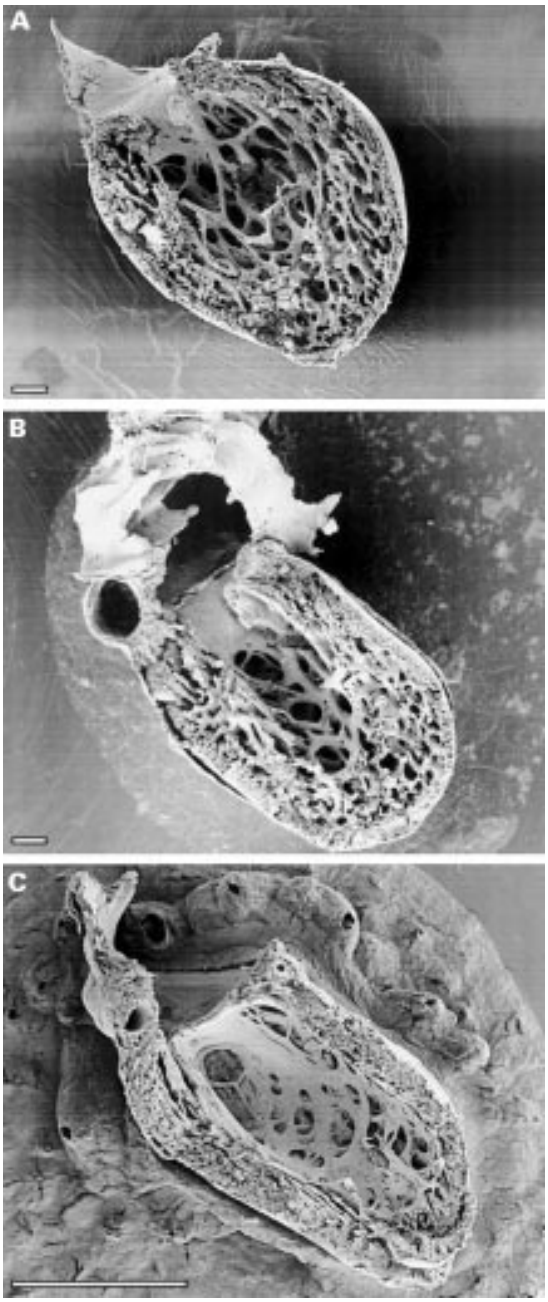

Figure 1 Parietal views of sagitally dissected human embryonic left ventricles showing the process of normal trabecular compaction. During early embryogenesis ventricular trabeculation develops in the apical region soon after looping, and serves primarily as a means to increase myocardial oxygenation in the absence of coronary circulation. Concomitant with ventricular septation, the trabeculae start to compact in their portions adjacent to the outer compact myocardium, adding substantially to its thickness. (A) Abundant fine trabeculae are present at six weeks. (B) The trabeculae start to solidify at their basal area, contributing to added thickness of the compact layer, at 12 weeks when ventricular septation is completed. (C) The compact layer forms most of the myocardial mass after completion of compaction in the early fetal period. Scale bars 100 μm (A, B), 1 mm (C). (A) and (C) from Sedmera et al.[11]

during the early stages of the disease, before left ventricular dilatation and systolic dysfunction are apparent. Currently, oral anticoagulation is recommended for all adult patients in whom IVNC is diagnosed, irrespective of left ventricular size and function.[5]

Echo technicians involved in family screening of the cardiomyopathies should be made aware of this condition. The new echo criteria set out in this issue of *Heart* should make the task of diagnosing IVNC, even in the asymptomatic individual, a more achievable goal. The next challenge will be making cardiologists more familiar with this condition and the associated natural history. This can only realistically be achieved when IVNC is established as a distinct cardiomyopathy.

A M VARNAVA

Department of Cardiology,
London Chest Hospital,
London E2 9JX, UK
avarnava@sghms.ac.uk

I would like to gratefully acknowledge the help of Dr David Sedmera, Department of Cell Biology and Anatomy, Medical University of South Carolina, USA, in providing the illustrations.

1 Chin TK, Perloff JK, Williams RG, *et al*. Isolated noncompaction of left ventricular myocardium: a study of eight cases. *Circulation* 1990;**82**:507–13.
2 Lauer RM, Fink HP, Petry EL, *et al*. Angiographic demonstration of intramyocardial sinusoids in pulmonary atresia with intact ventricular septum and hypoplastic right ventricle. *N Engl J Med* 1964;**271**:68–72.
3 Dusek J, Bohuslav O, Duskova M. Postnatal persistence of spongy myocardium with embryonic blood supply. *Arch Pathol* 1975;**99**:312–17.
4 Bleyl SB, Mumford BR, Thompson V, *et al*. Neonatal, lethal noncompaction of the left ventricular myocardium is allelic with Barth syndrome. *Am J Human Gen* 1997;**61**:868–72.
5 Oechslin EN, Attenhofer Jost CH, Rojas JR, *et al*. Long-term follow-up of 34 adults with isolated left ventricular noncompaction: a distinct cardiomyopathy with poor prognosis. *J Am Coll Cardiol* 2000;**36**:493–500.
6 Ritter M, Oechslin EN, Sutsch G, *et al*. Isolated noncompaction of the myocardium in adults. *Mayo Clinic Proc* 1997;**72**:26–31.
7 Robida A, Hajar HA. Ventricular conduction defects in isolated noncompaction of the ventricular myocardium. *Pediatr Cardiol* 1996;**17**: 189–91.
8 Ichida F, Hamamichi Y, Miyawaki T, *et al*. Clinical features of isolated noncompaction of the ventricular myocardium. *J Am Coll Cardiol* 1999;**34**: 233–40.
9 Shah CP, Naji KS, Thakur RK, *et al*. Spongy left ventricular myocardium in an adult. *Texas Heart Institute Journal* 1998;**25**:150–1.
10 Jenni R, Oechslin E, Schneider J, *et al*. Echocardiographic and pathoanatomic characteristics of isolated left ventricular non-compaction: a step towards classification as a distinct cardiomyopathy. *Heart* 2001;**86**:666–71.
11 Sedmera D, Pexieder T, Vuillemin M, *et al*. Developmental patterning of the myocardium. *Anat Rec* 2000;**258**:319–37.