Hypertrophic cardiomyopathy (HCM) has been considered rare among the Black population of southern Africa. We report 7 patients with the disease who presented during a 14-month period. Current concepts in the approach to the diagnosis and treatment of HCM are discussed. It is possible that with greater awareness of the occurrence of the condition in Blacks the diagnosis of HCM will be made in more members of this population group.

Summary
Hypertrophic cardiomyopathy (HCM) is an important cardiac lesion to diagnose. Although some patients are asymptomatic, others complain of angina pectoris, syncope or shortness of breath, and sudden death may occur. The disease is often familial, inherited as a mendelian dominant gene with variable penetrance.

HCM is not uncommon among White South Africans but only 4 Black HCM patients have been reported, and the disease has been considered to be rare in this racial group. We report 7 Black patients with HCM seen in the Division of Cardiology, Baragwanath Hospital, over a 14-month period, in order to draw attention to the condition in South African Blacks. The diagnosis and current concepts of the pathophysiology and management of HCM are discussed.

Patients and methods
The clinical data are summarized in Table 1. All patients claimed to be of pure Black descent. They belonged to different Bantu tribes: there were 3 Tswanas, 2 Xhosas and 1 each of Zulu and Venda origin. Five of the 7 were males and all were young (age range 19–38 years). Anginal-type chest pain was the presenting symptom in 5 patients. One patient claimed to be asymptomatic except for having had two episodes of acute breathlessness, for which he was admitted to hospital with pulmonary oedema. The 7th patient was asymptomatic and had been referred for evaluation of a harsh systolic murmur detected during routine physical examination for insurance purposes. The duration of symptoms varied, but only 1 (patient 5) had a history exceeding 2 years.

Physical examination revealed left ventricular hypertrophy (LVH) in all patients, with a prominent presystolic impulse at the apex in 6. A 'jerky', rapidly rising pulse was readily apparent in 4. The splitting of the second heart sound was abnormally narrow or partially reversed in all 7 patients. All had a delayed onset systolic ejection murmur; this increased in intensity on standing and became softer on squatting in 3. The ECG showed severe LVH with T-wave inversion over the left ventricle in all patients, in 4 of whom deep septal Q waves were also present. In only one instance (patient 5) was the heart enlarged as seen on radiography, but all 7 had a shelf-like outline to the left heart border which gave the left ventricle a 'bulky' appearance compatible with LVH (Fig. 1). Signs of pulmonary venous hypertension were present in 4 patients.

Echocardiography was diagnostic of HCM in all patients (Table II). In 5 both M-mode and high quality real-time two-dimensional echocardiograms were recorded, whereas in the remaining 2 (patients 2 and 3) the M-mode technique only was available. Echocardiography showed severe LVH (Fig. 2) in all patients; the hypertrophy was asymmetrical, mainly involving the septum, in 5. Systolic anterior motion (Fig. 3) of the anterior mitral leaflet was present in these 5 patients, in 3 of whom mid-systolic closure of the aortic valve was also seen.

Fig. 1. Postero-anterior chest radiograph of patient 7. The cardiothoracic ratio is 0.50 but there is a prominent shelf-like appearance to the left heart border which gives the left ventricle a 'bulky' appearance, and is compatible with LVH.
### TABLE I. CLINICAL, ELECTROCARDIOGRAPHIC AND RADIOGRAPHIC FINDINGS

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Race</th>
<th>Presenting symptoms</th>
<th>Duration of symptoms</th>
<th>Disability*</th>
<th>ECG</th>
<th>Chest radiograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28</td>
<td>M</td>
<td>Tswana</td>
<td>Chest pain, palpitations, shortness of breath</td>
<td>2 yrs</td>
<td>2b</td>
<td>Severe LVH, deep septal Q waves</td>
<td>CTR 0.45, 'bulky' LV, pulmonary venous hypertension</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>M</td>
<td>Zulu</td>
<td>Chest pain</td>
<td>1 yr</td>
<td>2a</td>
<td>Severe LVH, prominent Q waves in leads I and V3-V6</td>
<td>CTR 0.50, 'bulky' LV</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>M</td>
<td>Xhosa</td>
<td>Chest pain, palpitations</td>
<td>6 mo.</td>
<td>2a</td>
<td>Severe LVH, septal Q waves in leads I and aVL</td>
<td>CTR 0.48, 'bulky' LV, pulmonary venous hypertension</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>M</td>
<td>Xhosa</td>
<td>Two episodes of pulmonary oedema. Otherwise 'asymptomatic' Chest pain</td>
<td>2 yrs</td>
<td>1</td>
<td>Severe LVH</td>
<td>CTR 0.50, 'bulky' LV, intermittent pulmonary oedema</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>F</td>
<td>Tswana</td>
<td>Chest pain</td>
<td>10 yrs</td>
<td>2a</td>
<td>Severe LVH</td>
<td>CTR 0.63, 'bulky' LV, pulmonary venous hypertension</td>
</tr>
<tr>
<td>6</td>
<td>35</td>
<td>F</td>
<td>Tswana</td>
<td>Chest pain, palpitations, shortness of breath</td>
<td>2 yrs</td>
<td>2b</td>
<td>Severe LVH</td>
<td>CTR 0.52 'bulky' LV, LA+, pulmonary venous hypertension</td>
</tr>
<tr>
<td>7</td>
<td>38</td>
<td>M</td>
<td>Venda</td>
<td>Asymptomatic</td>
<td>—</td>
<td>1</td>
<td>Severe LVH, deep septal Q waves</td>
<td>CTR 0.50, 'bulky' LV</td>
</tr>
</tbody>
</table>

*New York Heart Association grading:
CTR = cardiac to aortic ratio; LV = left ventricle; LVH = left ventricular hypertrophy; LA- = left atrial enlargement.

### TABLE II. ECHOCARDIOGRAPHIC, HAEMODYNAMIC AND ANGIOGRAPHIC DATA

<table>
<thead>
<tr>
<th>Cardiac pressures (mmHg)</th>
<th>Left ventricle (apex)</th>
<th>Peak systolic gradient</th>
<th>Angiography</th>
<th>EF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>Echocardiography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Severe LVH with small cavity, ASH, SAM of anterior mitral leaflet, midsystolic aortic leaflet closure</td>
<td>180</td>
<td>80</td>
<td>Severe LVH with septal hypertrophy, trivial MI</td>
</tr>
<tr>
<td>2</td>
<td>Severe LVH</td>
<td>200</td>
<td>50</td>
<td>Severe LVH, mild MI</td>
</tr>
<tr>
<td>3</td>
<td>Severe LVH with small cavity, ASH, SAM of anterior mitral leaflet</td>
<td>140</td>
<td>40</td>
<td>Severe LVH</td>
</tr>
<tr>
<td>4</td>
<td>Severe LVH</td>
<td>240</td>
<td>0</td>
<td>Severe LVH</td>
</tr>
<tr>
<td>5</td>
<td>Severe LVH with ASH, SAM of anterior mitral leaflet, midsystolic aortic leaflet closure</td>
<td>4,6,11</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Severe LVH with small cavity, ASH, SAM of anterior mitral leaflet</td>
<td>125</td>
<td>10 (35 on isoprenaline)</td>
<td>Severe LVH, small cavity and septal bulge</td>
</tr>
<tr>
<td>7</td>
<td>Severe LVH with small cavity, ASH, SAM of anterior mitral leaflet, midsystolic aortic valve closure</td>
<td>200</td>
<td>100</td>
<td>Severe LVH, small cavity and septal bulge</td>
</tr>
</tbody>
</table>

ASH = asymmetric septal hypertrophy; SAM = systolic anterior motion; MI = mitral incompetence; EF = ejection fraction.

Cardiac catheterization (Table II) was performed in all except patient 5. The left ventricular end-diastolic pressure was increased in 3, and in all 6 a prominent 'a' wave was recorded in this chamber. An intraventricular pressure gradient was present in 5 patients, but in the 6th there was no pressure difference at rest, after an ectopic beat or during isoprenaline infusion. In all 6 left ventricular angiography confirmed marked LVH and showed vigorous myocardial contraction with a markedly increased ejection fraction and a small left ventricular cavity. There was almost complete cavity obliteration of the ventricle in 4 of the 6 patients.

The patients were treated with a β-adrenergic blocking drug, with the addition of the calcium antagonist verapamil in patients 1 and 7. Symptoms improved in all, but patient 1 continues to complain of chest pain.
Discussion

Pathophysiology of HCM

In HCM there is inappropriate and sometimes considerable hypertrophy of the ventricular myocardium, predominantly affecting the left ventricle. The excessive LVH has two principal consequences: (i) ventricular relaxation and compliance are abnormal, diastolic ventricular stiffness is increased, ventricular filling is impaired and the end-diastolic pressure may be elevated; and (ii) myocardial contraction is more forceful and the distorted left ventricular cavity may produce an intraventricular pressure difference during systole, but this is not an invariable feature of the condition. The symptoms of HCM include angina pectoris (due to increased myocardial oxygen demand and a diminished diastolic coronary perfusion gradient), dyspnoea (the clinical manifestation of the raised left ventricular end-diastolic and left atrial pressures) and syncope (probably mainly due to
arrhythmias, but aggravated by the small left ventricular cavity size which limits the stroke output). Sudden death may supervene, especially during exercise or with emotion.

The pathogenesis of the inappropriate LVH is unknown. There may be an inherited malformation of muscle in different parts of the myocardium with fibre malalignment, resulting in abnormal ventricular stresses and excessive hypertrophy. The distribution of the abnormal regions would determine the precise geometry of the left ventricular cavity in a particular patient, and where there is marked septal hypertrophy the so-called 'obstructive' form of the disease usually results. In most patients this 'obstruction' (as seen on angiography or echocardiography) is subvalvar, but in a few instances it is midventricular (hour-glass type). Hypertrophy confined to the apical myocardium, giving a typical 'spade-like' appearance on angiography, has been emphasized by Japanese workers. It has been argued, however, that the pressure difference within the left ventricular cavity does not reflect a true obstruction to left ventricular emptying, but that rapid ejection during early systole and cavity obliteration can account for many of the haemodynamic, echocardiographic and angiographic features hitherto attributed to 'obstruction'.

Diagnostic features of HCM

The diagnosis of HCM should be suspected in any patient who has inappropriate, unexplained LVH. The arterial pulse often has a rapid upstroke, in contrast to the slow-rising pulse of aortic stenosis, since in HCM early systolic ventricular emptying is normal or increased. A second pulse wave, producing a bisferiens character, may be felt in late systole. On auscultation a delayed onset systolic murmur is almost always present, and this murmur changes characteristically with various haemodynamic alterations. Splitting of the second heart sound is abnormal and the pattern of the splitting, whether narrow, reversed or partially reversed, changes spontaneously within seconds and without apparent cause. The ECG is seldom normal and commonly suggests severe LVH. Deep septal Q waves may be present, especially in patients with excessive septal hypertrophy. Electrocardiographic evidence of unexplained LVH should always raise the possibility of HCM. The chest radiograph not infrequently shows only slight or even no cardiac enlargement as assessed by the cardiothoracic ratio. However, in our experience a shelf-like appearance to the left heart border is characteristic of HCM, and the diagnostic importance of this sign (Fig. 1) was confirmed in the present series.

The echocardiogram is diagnostic in HCM and has probably obviated the need for cardiac catheterization in most patients. The echocardiogram, and especially the real-time two-dimensional echocardiogram, shows the distribution and degree of LVH, the forceful contraction of the left ventricle with cavity obliteration, and the systolic anterior motion of the mitral valve which is present in some patients and is attributed to asymmetric hypertrophy on the mitral apparatus by the distorted left ventricular geometry. Mid systolic fluttering and closure of the aortic leaflets are usually associated with a significant intraventricular pressure gradient.

Management of HCM

The medical management of patients with HCM is aimed at decreasing left ventricular contractility and increasing ventricular compliance and cavity size. Beta-receptor blockade improves the haemodynamic state and is effective in the treatment of symptoms. The calcium antagonist verapamil also improves symptoms in many patients, and may decrease LVH after long-term use. Large doses of propranolol in conjunction with anti-arrhythmic drugs and pacemakers, Cannedo and Frank were able to reduce the overall mortality rate of patients with HCM to 0.5% per year. Since even asymptomatic patients are at risk of sudden death, all patients with HCM should be given a beta-blocker or calcium antagonist at adequate dosage and should undergo regular Holter monitoring in order to detect and treat potentially life-threatening arrhythmias. Echocardiography is a useful screening test for HCM, and should be used to detect HCM in family members of patients with the disease.

In patients with large intraventricular gradients surgical intervention (extensive left ventricular myectomy) may be indicated. Although good results have been reported, it is not clear whether this alters the long-term prognosis of the disease.

HCM in southern Africa

HCM is not uncommon in South African Blacks, but for many years was not recognized in the Black population. The disease may be less common in South African Blacks since there is a strong genetic factor. HLA typing has shown distinct trends in the HLA patterns of patients with HCM, but the patterns vary in different ethnic groups. HCM certainly occurs in North American Blacks, and it is possible that many Black patients in southern Africa have not been diagnosed because of having nonspecific, relatively minor symptoms or signs. Screening of a large number of subjects in this population by means of electrocardiography, radiography and echocardiography may enable more cases to be diagnosed. The problem of diagnosis is compounded by the fact that very large numbers of seriously ill Black patients are examined and treated in southern Africa. In this context patients with minor or atypical complaints (such as many patients with HCM have) either do not consult a medical practitioner or may not be referred to a specialist centre. Moreover, congestive cardiomyopathy is very common in this population, and it is possible that some patients with unexplained cardiac symptoms or cardiac enlargement are loosely diagnosed as having 'cardiomyopathy' without further investigation or referral. The fact that among the last 14 months we have seen 7 patients with severe HCM identical to that seen elsewhere in the world and to that occurring in White South Africans suggests that the disease is not as rare in this group as has been thought. A greater awareness of the condition may reveal more cases of HCM in the South African Black population.

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REFERENCES

Gastroduodenal motility — a comparison between domperidone and metoclopramide

R. A. HINDER, B. A. SAN-GARDE

Summary

Domperidone (Motilium) speeds the emptying rate of the smallest particle size of a digestible solid (radioactive cubed liver) but has no effect on the emptying rate of 400 ml of 5% dextrose in the normal canine stomach. Conversely, metoclopramide (Maxolon) speeds the emptying of the liquid, but slows the emptying rate of the digestible solid.

The effect of domperidone on canine gastric electrical activity is to increase the frequency and strength of action potentials in the stomach after fasting and to slow the rate of discharge of the pacemaker potential, an effect similar to that seen after feeding.

Much information has been gained over the past years concerning the effects and mode of action of metoclopramide (Maxolon) on gastroduodenal motility. This drug, probably a dopamine receptor blocker, has been shown to reverse the slowing of gastric emptying produced by dopamine and to speed the gastric emptying of liquids, barium and solid meals. 1,2 The action of metoclopramide appears to begin within 5 minutes and to last for at least 15 minutes. Terminal antral contractions and intragastric pressure increase and there is better co-ordination between antral and duodenal contractions. These effects have also been demonstrated in patients after vagotomy. Howard and Sharp 3 were able to produce more rapid emptying of the stomach of women in labour with metoclopramide than with placebo. Others have found no effect in subjects with normal rates of gastric emptying but were able to speed the emptying rate in patients with delayed gastric emptying. 4 Metoclopramide has found a valuable place in the treatment of patients with impaired motility of the upper gastro-intestinal tract and has also been of use in upper gastro-intestinal radiology and the placement of naso-intestinal tubes. 5 Similarly, domperidone (Motilium) antagonizes apomorphine-retarded gastric emptying 6 and has the same effect on dopamine-retarded gastric emptying. 7 These authors showed that it speeds the initial gastric emptying of a solid meal but has no effect on a semi-solid meal. Domperidone produces dilation of the pylorus. 8

The aim of this study was to compare the effect of domperidone and metoclopramide on the gastric emptying of a liquid (5% dextrose) and a digestible solid (radioactive cubed liver) in dogs. In addition we studied the effect of domperidone on the electrical activity of the antrum and duodenum in dogs.

Material and methods

Gastric emptying studies

Ten mongrel dogs each weighing approximately 15 kg were subjected to laparotomy under general anaesthesia, after which a Thomas cannula was implanted into the duodenum approximately 10 cm distal to the pylorus. The cannulas were brought through the anterior abdominal wall in the right flank and were kept tightly closed with brass plugs when not being used for gastric emptying studies. The animals were able to eat a normal diet while the cannulas were in place and gained weight. When the dogs had recovered from the operations, gastric emptying studies using either 5% dextrose or radioactive cubed liver were carried out.

Prior to a gastric emptying test each dog was starved of food but not water for 24 hours. The animals were then placed in loose-fitting canvas slings, where the cannula was unstopped and washed out with water. A Foley catheter was then directed via the cannula into the distal duodenum, where the bulb of the catheter was inflated with 8 - 12 ml water containing mercurochrome as a marker to indicate whether the balloon had burst. The inflated balloon allowed for the total diversion of duodenal...