Cardiovascular Topics

Echocardiographic screening for cardiovascular disease in central South Africa: expanding the role of echocardiography in patient referral

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Abstract

Introduction: Cardiovascular disease affects millions of people, resulting in significant rates of morbidity and mortality. Inadequate healthcare systems, combined with costly treatments, impose a high economic burden, with growing challenges in the public healthcare arena. The demand for equitable access to specialised services is high in a country where most of the population relies on public healthcare services.

Aim: This study investigated the shortcomings and possible solutions to expedite referral for appropriate diagnosis and therapy.

Results: In a sub-analysis performed on 2 523 first-time echocardiography referrals to a tertiary-care hospital, cardiac abnormalities were diagnosed in 74% of patients. Most significant were valvular disorders (33%) and secondary pulmonary hypertension (19%). More than a third of patients presented with severe valvular disease, indicative of progressive heart disease and late referral. Almost a half (44%) of patients with cardiomyopathy presented with severely impaired left ventricular systolic function at first referral (left ventricular ejection fraction <30%), suggesting missed diagnosis and/or late referral.

Conclusion: The study demonstrated a high demand for echocardiographic services from secondary regional and district hospitals in central South Africa. Late referrals can be attributed to long travelling distances and the number of regional hospitals. The availability of echocardiographic screening could fill the void in the current healthcare system to expedite diagnosis and effective referral.

Keywords: cardiovascular disease, echocardiography, central South Africa, screening, prevention

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Cardiovascular disease (CVD) affects millions of people, resulting in significant morbidity and mortality rates, the seriousness of which cannot be ignored.[1] Research shows a transition from communicable diseases to chronic non-communicable diseases in sub-Saharan Africa, where a vast number of the population is poor[2] and increasingly exposed to risk factors for non-communicable diseases (NCD) and CVD.[3] NCD accounts for 37% of deaths in sub-Saharan Africa, occurring much earlier in life than in high-income countries.[3] Inadequacy of healthcare systems, combined with costly treatments for heart disease, imposes a high economic burden with growing challenges in the public health arena.[3-5]

Late or undiagnosed cardiovascular disorders can be lethal and therefore strengthening efforts to ensure early diagnosis of CVD is needed.[6] The key role of echocardiography in the diagnosis and follow-up surveillance of cardiac abnormalities is widely acknowledged as an expansion of clinical evaluation.[7-9] Sekiguchi considered echocardiography as 'a visual stethoscope'.[10] It provides valuable information for early diagnosis, with a clear indication for timely and appropriate medical or surgical treatment, which is vital for decision making and patient management.[11]

Preliminary study data showed that most patients referred for echocardiography in central South Africa had low incomes (93%), were hypertensive (64%), and overweight and/or obese (57%). In 26% of referrals, no echocardiographic abnormalities were detected. Almost three-quarters of patients (74%) had abnormal echocardiographic findings, and disease profiles supported the impression of long-standing disease and late referrals (manuscript in preparation). Late diagnosis of severe cardiac disease inevitably leads to dire consequences, not only for

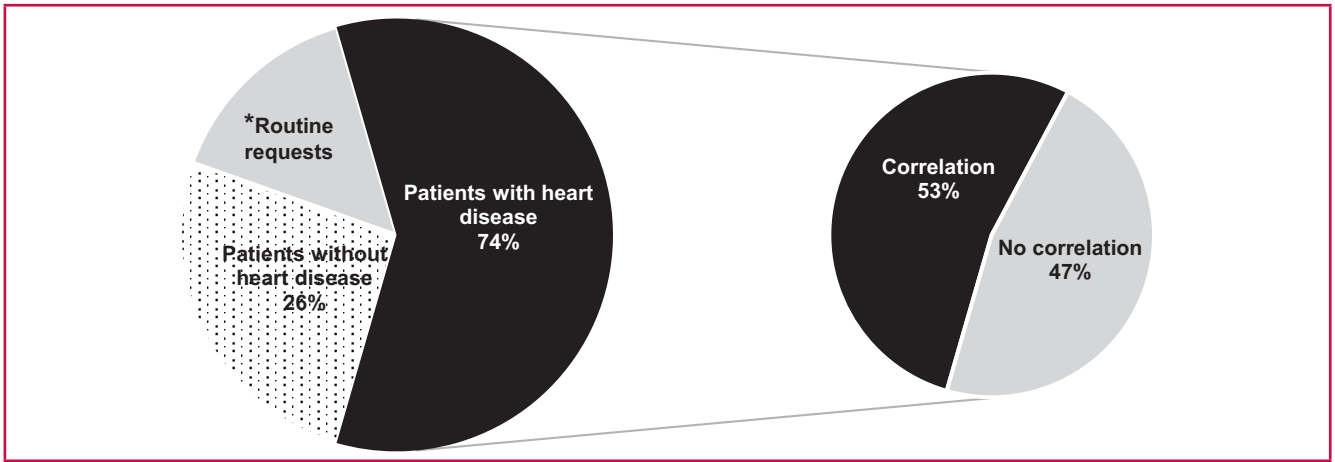

Fig. 1. Referral request versus confirmed echocardiographic diagnosis. The chart on the left represents patients in whom heart disease was present (74%). Out of these, only 53% had echocardiographic findings similar to the referral diagnosis. The remaining patients (47%) showed no correlation between the echocardiographic results and the initial diagnosis made by the referring official. *Routine referrals that were excluded.

the patient but also for the healthcare system. Echocardiographic screening has the potential to relieve the service burden by increasing the detection of cardiovascular disorders and reducing unnecessary referrals.[8]

This article aimed to highlight and identify the shortcomings of the echocardiographic referral system in central South Africa and propose recommendations to address these issues.

Methods

The study consisted of a review and sub-analysis of a descriptive, longitudinal, observational, hospital-based study conducted in the echocardiography laboratory of the division of Cardiology, Universitas Academic Hospital (UAH), Bloemfontein. Ethical approval was obtained from the Health Sciences Research Ethics Committee of the University of the Free State (UFS-HSD2019/0353/2506-0003) and the Free State Department of Health.

The patients (2 523) were referred for a first-time echocardiographic evaluation from September 2018 to December 2020. Echocardiographic abnormalities (n = 3 400) were confirmed in 1 868 patients. For this analysis, patients referred for routine pre-treatment assessments such as chemotherapy were excluded.

Echocardiographic abnormalities were reported according to the European Association of Cardiovascular Imaging consensus.[12] All reports of patients with primary valvular heart diseases were assessed to determine the severity of valvular disorders, according to the European Association of Echocardiography guidelines.[13] Primary valvular lesions were defined as primary abnormality of the valve apparatus.

Results

The accuracy of the referral diagnosis was evaluated in 1 487 reports after 381 routine requests were excluded. Only 53% (n = 793) of presumed clinical diagnoses correlated with the echocardiographic findings (Fig. 1).

Echocardiographic evaluations were performed on 2 523 patients, of whom 1 868 (74%) had abnormal findings. A total of 3 400 cardiac abnormalities were detected in these 1 868 patients. The most common echocardiographic abnormalities consisted of valvular disorders in 33% (n = 1 121), pulmonary hypertension in 19% (n = 651), left ventricular hypertrophy (hypertension) in 14% (n = 470), dilated cardiomyopathy in 10% (n = 340) and miscellaneous causes in the rest. Forty-four per cent (n = 150/340) of patients with a cardiomyopathy diagnosis had significant systolic functional impairment with a left ventricular ejection fraction (LVEF) of less than 30% at first presentation.

Aortic sclerosis was present in 62% (n = 700) of all valvular abnormalities and primary valvular disease in 38% (n = 421). Severe mitral stenosis was present in almost a third of patients (29%), and in 35% of patients, severe mitral regurgitation was diagnosed at first presentation. Severe aortic stenosis and severe regurgitation were observed in 42 and 44%, respectively (Table 1).

Discussion

Previous results of this longitudinal study demonstrated that travelling distances, late presentation and inappropriate referrals significantly burdened the echocardiographic laboratory in central South Africa (manuscript in preparation). Several findings support the need for at least basic echocardiographic services at peripheral hospitals.

Table 1. Severity of primary valvular lesions

	Valve lesion		
Disease	*Total (n = 279)*	*Severe (n = 107)*	*Mild/moderate (n = 172)*
Aortic stenosis, *n* (%)	67 (24)	28 (42)	39 (58)
Aortic regurgitation, *n* (%)	93 (33)	41 (44)	52 (56)
Mitral stenosis, *n* (%)	56 (20)	16 (29)	40 (71)
Mitral regurgitation, *n* (%)	63 (23)	22 (35)	41 (65)

Note: mixed lesions were excluded

The authors concluded that access to tertiary services appeared to be a challenge, hampered by numerous difficulties. The Free State is the third-largest province in South Africa by surface area (129 825 km^2), with primarily a rural population, giving rise to a low population density (infographic: Local government in the Free State, viewed 25 May 2023, https://southafrica-info.com/land/infographic-local-government-municipalities-free-state-south-africa/).

Only five regional hospitals service this province. UAH is the only tertiary public service providing specialised cardiology/cardiothoracic services for the population of central South Africa (Free State, Northern Cape and Lesotho). Patients first attend primary healthcare clinics, followed by a referral to a secondary institution (district or regional hospital). Our research showed that the overwhelming majority of patients were of low income and therefore relied on public health services.

It was demonstrated that the number of regional hospitals and travelling distances influenced referral patterns. The least number of patients were referred from the Xariep district in the Free State, which is understandable as this district has no regional hospital and a very low population density. On the other hand, Fezile Dabi referrals were less than 10%, regardless of two regional hospitals in the district.

Although the Mangaung district is significantly smaller than the Thabo Mofutsanyane district (9 886 vs 232 730 km^2), significantly more patients were referred from the Mangaung region (46 vs 15%). This could be attributed to the population density for Mangaung district, which has a population density of 80 versus 24 people/km^2. Furthermore, travel distances were short for patients residing in the Mangaung district and the district is equipped with three functional regional hospitals.

Primary valvular disease was by far the most common cardiac diagnosis in our population. It is a concern that more than a third of stenoses and regurgitations were classified as severe at first presentation. Valvular diseases are associated with increased mortality rates.[14] Furthermore, Nieminen *et al*. described the interchangeable impact between valvular heart disease and heart failure in Africa, and documented that a quarter of patients with heart failure result from underlying valvular dysfunction.[15] A South African heart failure study by Essop and co-workers identified primary valve disease in 8% of newly diagnosed heart failure cases.[16] Lung *et al.* highlighted the negative effect late referral of patients with valvular heart disease has on patient outcomes and recommended increased awareness of valvular disease.[17]

The severity of valvular lesions mirrors a definite pattern of late referral, as primary and secondary healthcare workers may not always appreciate clinical symptoms and signs. The ideal approach to accurate diagnosis involves objective proof, which can only be provided by echocardiographic screening since it allows for a more accurate diagnosis of cardiac disease.[18] It stands to reason that early detection of disease before complications set in will result in improved rates of mortality and morbidity and substantially decrease the burden and cost of care.

The presence of secondary pulmonary hypertension is a sign of progressive heart disease, as clinical signs usually become evident only after decompensation occurs, and late initiation of treatment leads to poor outcomes in these patients.[19] Secondary pulmonary hypertension, resulting from valvular and left heart disorders, was the second most common abnormality diagnosed, and observed in 19% of cardiac abnormalities. This is once again a reflection of long-standing or advanced cardiac disease, most likely due to incorrect diagnosis and late referral. Echocardiography can instantly confirm the presence of pulmonary hypertension and probable aetiology.[20]

The fact that 44% of patients with dilated cardiomyopathy had an LVEF of less than 30% indicates that a noteworthy number of patients presented with severely impaired left ventricular systolic function at first referral, suggesting missed diagnosis and/or late referral. Heart failure with late presentation is commonly seen in sub-Saharan Africa.[21] Clinical diagnosis of cardiomyopathy is often only made after complications become evident. It is known that advanced heart failure can result in multi-organ failure and mortality, while timely diagnosis and appropriate care are likely to change patient outcomes.[22] Optimally, patients should be referred prior to advanced illness and irreversible organ damage.

The use of echocardiography in heart failure patients is strongly recommended as both systolic and diastolic function and filling pressures can accurately be determined.[23] Echocardiography also allows for the diagnosis of underlying diseases as well as the type of cardiomyopathy, which permits the best assessment regarding treatment, directly affecting patient prognosis. Follow-up echocardiographic screening is also indicated to monitor the effectiveness of treatment.[24]

The economic burden of heart failure has serious implications for healthcare systems. Recurrent hospital visits inflict extra costs, escalating the financial burden of symptomatic heart failure. Ogah and colleagues reported the cost of in-hospital treatment of heart failure at 46% of the total healthcare expenditure in Nigeria.[25] Atherosclerosis and high blood pressure aggravate heart failure on the African continent. Undiagnosed, untreated heart abnormalities often result in heart failure and cardiomyopathy, with numerous costly hospital admissions.[26]

Almost a third of the patients had aortic valve sclerosis and two-thirds presented with hypertension, raising several concerns. Aortic valve sclerosis and hypertension are cardiovascular disease risk factors.[27] There is ample evidence linking hypertension to the development of cardiovascular disease.[28,29] Combined, hypertension results in earlier valve degeneration and heart failure with severe diastolic dysfunction.[30] Similarly, Olsen and colleagues reported aortic valve sclerosis in 40% of hypertensive patients aged 55 to 80 years.[31] Considering the evidence and the high presence of hypertension and aortic valve sclerosis in the current study population, we have reason to anticipate an increase in the cardiovascular disease burden in central South Africa, with rising demand for specialist treatment.

There was a poor correlation between referral requests and echocardiographic diagnosis; almost half of the cardiac diagnoses were incorrect. This highlights the need for support and targeted services to improve early and accurate diagnosis at referral sites. Kimura and colleagues compared clinical diagnosis of cardiac lesions with echocardiographic screening in an emergency department. They reported that only 25% of heart lesions were accurately diagnosed by clinical examination and concluded that even rapid cardiac screening provided a more accurate diagnosis of a broad spectrum of abnormalities, including valvular disease, impaired ventricular function, aortic anomalies and pericardial disease.[18]

Overall, these observations portray an ominous illustration of advanced disease states together with delayed patient referrals in our central South African region. Early recognition of cardiac conditions is key to timely referral and optimised patient care. Identifying patients who should be referred to a tertiary hospital for treatment can be supported by echocardiographic screening at regional hospitals. This will also assist in preventing and reducing unnecessary referrals (26% in central South Africa) of patients without cardiac abnormalities, which should decrease the burden on the already congested system.

Effective screening of patients with suspected heart disease at regional hospitals can save costs and lives.[32] A growing body of evidence confirms the possibility of improving the diagnostic pathway using echocardiographic screening at all levels of healthcare services. Detection of asymptomatic cases of heart disease is a major advantage of echocardiography, making it an essential diagnostic tool for accurately identifying and evaluating cardiac abnormalities in present-day cardiology practice.[33]

To expand services to rural patients in sub-Saharan Africa, Rwandan nurses received training in basic echocardiography. They were taught to master only the parasternal long-axis and subcostal images. Surprisingly, results reflected the success of this initiative, showing accurate diagnosis in 92% of patients.[34] The immediate visualisation of cardiac morphology and function cannot be mastered to the same extent by auscultation alone.[33]

The authors advocate the decentralisation of echocardiographic services from the central tertiary facility to regional hospitals in the central region of South Africa to accelerate patient referral to specialist services. This may improve service delivery in all districts and relieve the burden on the central echocardiographic laboratory by eliminating unnecessary referrals. Consideration should also be given to the implementation of a central electronic database of cardiovascular disease patients to serve the entire region of central South Africa. Future research may investigate the possibility of training for echocardiographic screening development and the development of an appropriate curriculum.

Conclusion

The study demonstrated a high demand for echocardiographic services from secondary regional and district hospitals in central South Africa. Implementing a more available screening service would address gaps in access in current patient healthcare delivery. Echocardiographic screening should be an integral part of diagnosis, decision making and referral of patients, at least at the regional hospital level. The establishment of such a screening service would support local physicians, increase early diagnosis of cardiovascular diseases, and decrease inappropriate referrals, resulting in more cost-effective service delivery by the Free State Department of Health. If a well-functioning screening service could be implemented in the region, it may ultimately enhance healthcare for patients in central South Africa. Benefits for patients include timely identification and referral of patients who qualify for surgical and medical treatment.

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