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Cardiac murmurs: echocardiography in the assessment of patients requiring antibiotic prophylaxis for dental treatment

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Abstract

Background: Traditionally patients who indicate that they have a heart murmur or who indicate that they have had rheumatic fever are given antibiotic prophylaxis for dental treatment. This is commonly done without further assessment of the patient's actual endocarditis risk. Echocardiography is a non-invasive method of assessing cardiac valve function and haemodynamics.

Methods: Consecutive patients who were referred to a private practice oral and maxillofacial surgeon for dentoalveolar surgery and indicated that they had a cardiac problem and usually had antibiotic prophylaxis, were evaluated. Those with a clear indication for prophylaxis, for example had prosthetic heart valves or previous infective endocarditis, received antibiotic prophylaxis. Where there was uncertainty, they were referred for an echocardiogram, and if abnormal, a formal cardiology review.

Results: Three hundred and seventy patients out of approximately 20 000 (1.85 per cent) indicated that they had a cardiac murmur and usually received antibiotic prophylaxis for dental treatment between 1 February 1997 and 1 February 2005. Two hundred and sixty-two (71 per cent) were female and 108 (29 per cent) were male; age range 0.7 to 98 years, average 37.6 years. Two hundred and seventy (72 per cent) had normal hearts with no indication for antibiotic prophylaxis. Of the 100 (28 per cent) patients with abnormal findings, they were on average older; 49.5 years, range 0.7 to 87 years. Of these, 50 (14 per cent) met current indications for antibiotic prophylaxis.

Conclusion: Patients who present for dental treatment indicating that they require antibiotic prophylaxis for cardiac condition need to be fully evaluated. In this study only 50 of 370 patients (14 per cent) required antibiotic prophylaxis. The remaining 320 (86 per cent) would have no benefit but a risk of adverse reaction to the antibiotic.

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INTRODUCTION

Traditionally, all patients who indicated that they have a cardiac murmur or have had rheumatic fever with or without rheumatic heart disease were given antibiotic prophylaxis prior to dental treatment. This is on the basis that cardiac murmurs are one of the risk factors for bacterial endocarditis.[1-3] The wider issue of bacterial endocarditis and antibiotic prophylaxis in dental treatment is the subject of a separate review.[4] The particular issue with cardiac murmurs is that they are common, may be transient, are of a variety of causes and the clinical diagnosis by auscultation is subjective and can be difficult. The disease profile of cardiac murmurs has also significantly changed in the last few years and dental treatment has not kept up with this. Indeed, many would argue that the current practice is that all patients with cardiac murmurs would be given antibiotic prophylaxis. Hence, recognition of the benign nature of a heart murmur avoids the empirical use of antibiotic prophylaxis in those who do not require it.

Heart sounds are made in the normal cardiac cycle by the closure of the heart valves. The normal arrangement of the four heart valves in systole and diastole is shown in Fig 1. Oxygenated blood from the lung continuously fills the left atrium and enters the left ventricle through the mitral valve. This valve has two leaflets. When the left ventricle contracts, blood is expelled under considerable pressure into the aorta via the aortic valve which has three leaflets. After circulating through the body, the blood continuously fills the right atrium and enters the right ventricle through the tricuspid valve. As the right ventricle contracts, blood is expelled into the pulmonary veins via the pulmonary valve which also has three leaflets. The pulmonary circulation is at a lower pressure than the systemic circulation. Normal valves only allow blood to flow in one direction and have minimal resistance. Thus blood through normal valves occurs in a laminar flow which is hard to auscultate.

Heart murmurs are the sounds generated by turbulent or non-laminar blood flow. Valvular pathology will result in both abnormal heart sounds and murmurs. Valvular pathology may result in three types of flow abnormality. In valvular stenosis the blood flow is in the normal direction but the pressure is abnormally high and turbulent. In valvular incompetence, the blood flow partly reverses back through the valve and is also turbulent. Complex types have a combination of stenotic and regurgitant flow. Other cardiac anomalies are often present in these complex types.

The aetiology of heart sounds and murmurs is complex and multiple. They range from benign variations in physiologic function (innocent murmurs), to congenital and acquired pathologic changes within the valves and surrounding structures.[5] They may also

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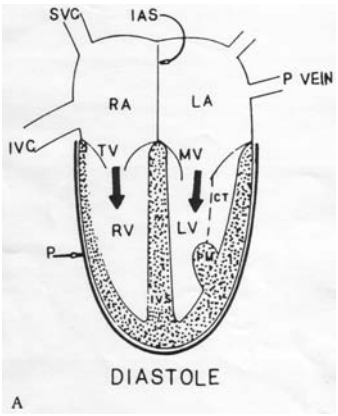


SVC	Superior Vena Cava
IVC	Inferior Vena Cava
RA	Right Atrium
RV	Right Ventricle
PA	Pulmonary Artery
LA	Left Atrium
LV	Left Ventricle
AO	Aorta
CT	Chorda Tendineae
P	Pulmonary Vein
TV	Tricuspid Valve
PV	Pulmonary Valve
MV	Mitral Valve
AV	Aortic Valve

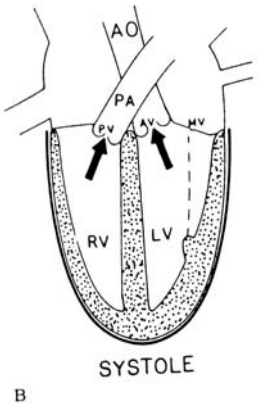
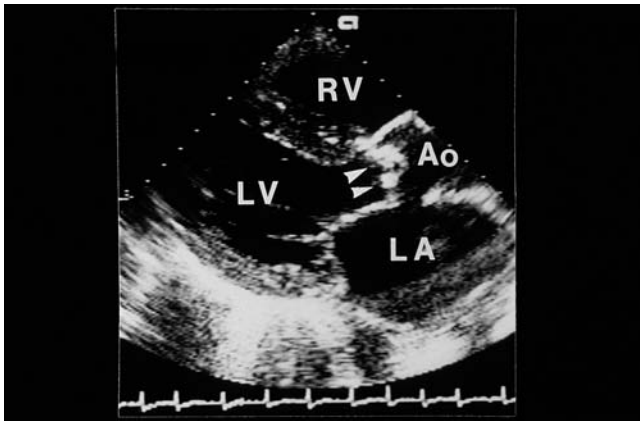


Fig 1. Diagrammatic cross-section of the heart. (A) diastole and (B) systole. The direction of flow and vales involved are shown.

be secondary to cardiac surgery to repair or replace cardiac valves with various grafts or prosthetic devices or due to hormonal changes in pregnancy.[6] Heart murmurs are graded from 1 to 6 with the most severe murmur graded as 6. Only very experienced clinicians are able to detect a murmur graded as 1 and murmurs graded as 6 are clinically quite evident. It has been shown that the intensity of a murmur correlates well with the severity of valvular regurgitation.[7]

The primary diagnosis of valvular disease is by auscultation of the heart using a stethoscope. It is a variable and subjective method of examination which does not quantify nor qualify with accuracy the severity of a pathological heart lesion.[8-10] A systolic murmur is a common finding on auscultation and ranges in prevalence from 52 per cent in adults to 80 per cent in children.[8] Whilst detection of gross abnormalities may be straightforward, the finer details of the auscultation require much experience and interpretation. Ultrasound investigation of the heart, also known as echocardiography, is a non-invasive, highly accurate and effective method of cardiac diagnosis.[11-15] Cardiac Doppler ultrasonography and colour flow imaging methods are further non-invasive applications of ultrasonography which has further developed cardiac diagnosis particularly for valvular and flow disorders.[16,17]

In principle, ultrasonography is simple. An ultrasound pulse is produced, directed through the tissue and the echoes produced are recorded and analysed. The physics is complicated, the equipment



LA	Left Atrium
AV	Left Ventricle
AO	Aortic Valve
Arrows	Aortic calcification
RV	Right Ventricle

Fig 2a. Calcified aortic valve.

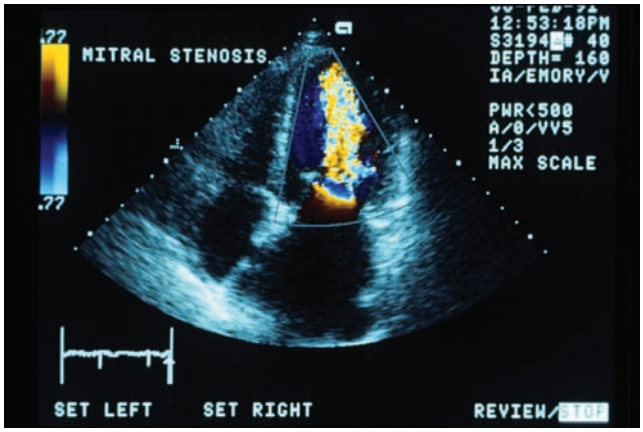


Fig 2b. Mitral stenosis – Abnormal flow through mitral valve.

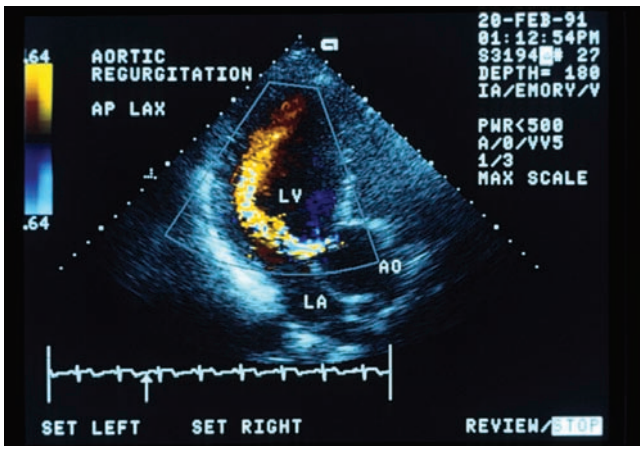


Fig 2c. Aortic regurgitation – Backflow into the left ventricle from the aortic valve which is not closing effectively.

sophisticated and considerable skill and training is required in the interpretation of the results. It has the benefits of being safe, non-invasive, real time display, cost effective and reproducible with accuracy. Doppler ultrasonography involves the use of ultrasound to measure the velocity of moving particles. Originally, this was used in medicine to measure the speed and motion of red blood cells in straight peripheral vessels.

This has subsequently been refined to measure the more complex movements of red blood cells over the valves and through the heart. Current advances in technology allow non-invasive, real time display of the colour image of blood flow. Flow towards the transducer is red, away blue, and turbulent flow a mosaic of white, yellow and green[15] (Figs 2a-2c).

In skilled hands the combination of auscultation and echocardiography with colour Doppler ultrasound will enable the cardiologist to accurately determine the presence or absence of cardiac valvular disease and the flow characteristics of blood through the heart. Especially useful is the echocardiogram in identifying the type of valvular lesion in non-specific murmurs in patients aged 0-1 years or over 50 years.[9] The prevalence of systolic murmurs in the geriatric population is common and is reported to be as high as 60 per cent. The cause is usually due to insignificant calcific aortic disease. Echocardiography is helpful in identifying those murmurs that are significant and due to hypertrophic cardiomyopathy.[17]

Consequently, the identification of a heart murmur is of direct significance in the risk assessment for bacterial endocarditis. In a normal heart, a bacteraemia will pass directly through the heart in a laminar flow. When there is turbulent flow secondary to abnormal valvular function, there is an increased risk that bacteria may settle out from the blood flow and colonize platelet aggregations on the valves. This is more likely if the valves are damaged. Valves may also be damaged by abnormal blood flow, particularly at the site where high velocity jet strikes the endocardium.

The aim of this study was to assess the need, by means of echocardiography, for antibiotic prophylaxis in patients who indicated that they had a heart murmur for which they were usually prescribed antibiotics prior to dental treatment.

METHOD AND MATERIALS

All patients who were referred to an oral and maxillofacial surgeon in private practice between 1 February 1997 and 1 February 2005 completed a medical history questionnaire. All who answered positive to the following questions had their cardiac history reviewed: Do you have or have you had heart problems/murmurs?; Do you have or have you had rheumatic fever?; Do you have antibiotic cover for dental treatment?

Patients were excluded from the study if they had a clear history and current medical treatment for known cardiac risk factors for endocarditis. These included prosthetic heart valves or other cardiac surgery, previous endocarditis or cardiomyopathy, or cardiac failure. These patients were treated in accordance with standard guidelines. The remainder of the patients were referred to a cardiology clinic for evaluation of their heart murmur by electrocardiography and Doppler flow ultrasonography. In the presence of abnormality they then had formal cardiology review.

RESULTS

Three hundred and seventy patients (in a practice of over 20 000 patients = approximately 1.85 per cent of total patient population) indicated on the questionnaire that they had a heart murmur or have had rheumatic fever and usually had antibiotic cover for dental treatment. They had no other cardiac history and, generally, were fit and well.

Two hundred and sixty-two patients (71 per cent) were female and 108 were males (29 per cent). The average age of the patients was 37.6 years with a range 0 years 7 months to 98 years.

The echocardiogram results were fully normal in 270 (72 per cent) patients. The 100 patients with abnormal echocardiograms were older; average age 49.5 years, range 0.7m to 87 years. Seventy (70 per cent) were females and 30 (30 per cent) were males. This is a similar gender distribution to the whole group. The oldest patient in the study, a 98-year-old male, had a normal heart.

The distribution of heart murmurs is tabled with subgrouping into one, two, three and four valvular lesions contributing to the heart murmur (Table 1).

Table 1. Distribution of abnormal valvular findings

	Valve	No.	M.	F.	Age and range
Single valve	MV	29	10	19	34.4 (0.7 months–75)
	AV	10	3	7	50.5 (16–78)
	PV	10	5	5	30.6 (18–51)
	TV	12	1	11	41.3 (13–75)
Two valves	MV,AV	7	2	5	69.8 (37–88)
	MV,TV	15	3	12	56 (28–78)
	AV,TV	3	1	2	49.3 (21–74)
	TV,PV	3	1	2	46.6 (21–81)
Three valves	MV,AV,TV	4	3	1	77 (71–85)
	MV,TV,PV	3	3	0	79.6 (75–85)
	AV,TV,PV	1	0	1	29
Four valves	MV,AV,TV,PV	3	0	3	80.3 (67–87)

DISCUSSION

This study shows that 72 per cent of all patients who indicated that they had a heart murmur and usually had antibiotics for dental treatment in fact had normal hearts. Thus they were never at risk of endocarditis. They were, however, at risk to an allergic reaction from having antibiotic prophylaxis. The allergy rate to penicillin type antibiotics is approximately 3 per cent for urticarial type allergic reactions.[18] Anaphylaxis occurs with an incidence of 1 in 2500 to 5000 and death as a result of anaphylaxis occurs in 10 per cent of anaphylaxis patients.[19] Besides these acute risks there is further risk of later developing allergy with each course of antibiotics and also the problems of development of resistant strains.[20]

Of the patients who had positive findings from the examination, there was a wide range of ages and different heart valves involved. Some have a high risk of developing endocarditis and some low.

The mitral valve lesion either as an isolated lesion or in conjunction with other valvular lesions is by far the

most common heart valve lesion and is due to left ventricular dysfunction. The next most common lesion is the tricuspid lesion and is consequent to left heart pathology causing pulmonary hypertension and subsequent tricuspid valve damage.

Specific analysis of the above results shows that the majority of heart valve lesions occur in the elderly population. Increasing involvement of a greater number of valves is also indicative of the ageing patient.

The bias in female gender may reflect the population of females attending for dental treatment more often than males, secondly, reporting more often their medical problems and thirdly, being diagnosed with a heart murmur during pregnancy and continuing to relay that advice even though the murmur had resolved post-partum.

Of particular significance to dentistry is the likelihood of the patient having rheumatic fever. The clinical significance of rheumatic fever is often misunderstood. Rheumatic fever is an autoimmunological disease triggered following a streptococcal sore throat. Rheumatic fever occurs due to a complex cross reactivity of streptococcal antigen and antibody produced against the antigen within the immune system. These antigen–antibody complexes may localize within tissues (heart, kidney and joints) and by activating complement lead to tissue damage and may result in one of, or a combination of, rheumatic heart disease, arthritis or nephritis. Consequently, a patient may have had rheumatic fever with or without any combination of heart, joint or kidney complications. Rheumatic fever was a common disease up until the development of antibiotics. In developed countries it has now virtually disappeared. Thus the Australian population of patients who may have had rheumatic fever in their youth has now aged and has probably largely died out. Sadly, this is not true for the indigenous Australian population as rheumatic fever is still common amongst Aboriginals. The exception to this is individuals who were not born in Australia but have migrated from less developed countries, in particular Asia and the Indian sub-continent. In those countries rheumatic fever remains a problem. Thus if the patient does indicate that they have had rheumatic fever it does make a difference to which part of the world they were in when the disease occurred. The other issue with rheumatic fever is that the name is easily confused with rheumatoid arthritis and other aches and pains. In a number of studies it has been indicated that of all patients who indicate that they had rheumatic fever most, in fact, had not.[1-3]

CONCLUSIONS

The issue then remains as to how these findings should alter traditional and, indeed, still largely current practice in dentistry. It is still mandatory that proper medical histories are taken and the patient is carefully evaluated as to the actual extent of cardiac risk. If there are doubts the patient should be referred to either their general medical practitioner or an oral and maxillofacial surgeon to arrange appropriate cardiological investigations including echocardiography. Most dental practices will also have a number of longstanding patients for whom in good faith antibiotic prophylaxis has been arranged for dental treatment. Again, to minimize the risk of harming the patient through antibiotic prophylaxis, it would be appropriate to firstly discuss the issue with the patient and then arrange appropriate investigations. The patient can then have an informed consent discussion as to whether they need antibiotic prophylaxis and for which types of dental treatment.

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