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HYPERTENSION

HYPERTENSION MANAGEMENT IN ATHLETES

Arterial hypertension is a common problem identified during clinical evaluation of athletes, both amateurs and professionals. The European Society of Cardiology (ESC) guidelines advocate regular physical activity as a Class IA recommendation for the prevention and treatment of cardiovascular disease, which is contributing to the growing number of hypertensive individuals who train regularly and wish to engage in competitive sport. The largest study on arterial hypertension in athletes in Europe (n = 2000; age 25 ± 6 years; 64% males) reported a prevalence of 3%.

Hypertension is a risk factor for coronary artery disease progression and left ventricular (LV) hypertrophy and accelerates damage in the retina and kidneys and an increased risk of spontaneous intra-cerebral haemorrhage. Furthermore, an acute increase in blood pressure (BP) during effort may trigger atherosclerotic plaque rupture leading to ischaemic myocardial or cerebrovascular events. Therefore, identification of hypertensive individuals is paramount in the setting of pre-participation screening, to implement a healthier lifestyle and appropriate management.

Definition
Hypertension is defined as systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg repeatedly measured in the office and the threshold for an elevated 24 h ambulatory blood pressure monitoring (ABPM) is ≥130/80 mmHg (daytime: ≥135/85 mmHg; night-time: ≥120/70 mm Hg).

During exercise, physiologically systolic BP increases and diastolic BP remains stable or mildly decreases. Even though the association between an exaggerated BP response during exercise testing and cardiovascular events is not well established, it has been related to incident hypertension. Also, 200 mmHg at 100 W has been demonstrated to independently predict long-term mortality in healthy middle-aged men.

Assessment
Assessment of hypertension has to be carried out in the context of other associated clinical conditions and resulting target organ damage. Testing for microalbuminuria after 24h rest and tissue Doppler imaging for plaque detection of carotid arteries may be considered in high-risk subjects.
Secondary causes need to be excluded, which may account for 5–10%, as they may be reversed with appropriate management. Widely used supplements, energy drinks, medications (including anti-inflammatory drugs or thyroid hormones for weight reduction), or performance enhancing substances (e.g. erythropoietin, anabolic steroids) are an underestimated cause of secondary hypertension.
Secondary causes of hypertension should be sought in individuals if:

1. Age at onset <30 years,
2. Absence of risk factors including family history of hypertension,
3. Grade 3 hypertension (>180/110 mmHg) or hypertensive emergencies, and
4. Sudden increase in BP in a previously normotensive individual or resistant hypertension despite medical treatment.

Echocardiography has its place to assess LV hypertrophy and mass, impaired relaxation or systolic dysfunction, valves, and the ascending aorta. Long-term, high-volume, and high-intensity endurance sport itself may induce enlargement of all cardiac cavities and mild LV hypertrophy, better known as athlete's heart. Whereas these physiological adaptations are reversible by detraining, remodelling caused by hypertension is not, but is amenable to effective BP lowering therapy.

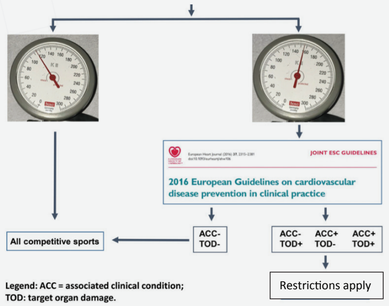
Exercise testing should be routinely performed to assess exercise capacity and to rule out exercise-induced hypertension. Blood pressure values obtained during exercise should not be used for a definitive diagnosis of hypertension. Annual follow-up preferably with ABPM and particular attention to cardiovascular risk factors is warranted, but without restriction from any competitive sport.

Treatment
Appropriate non-pharmacological measures should be recommended: salt restriction, weight reduction when obesity is present, alcohol restriction, increased consumption of vegetables and fruits, smoking cessation, discontinuation of supplements, ergogenic, and/or anti-inflammatory drugs.

Athletes who compete at national or international level have to review the current list of prohibited substances and methods of the World Anti-Doping Association before starting drug therapy. Angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers are the preferred choice (with the exception of females of reproductive age) as they do not affect exercise capacity and are not on the doping list. Alternatively, calcium channel blockers are a preferred choice in athletes. Combination drugs should be considered if needed as they may improve compliance. Beta blockers are rarely used as second line therapy, as they can generally not be given in athletes with bradycardia <50/min and/or second or third degree AV block. Furthermore, different beta blockers (selective/non selective, older/newer compounds, with/without vasodilatory properties) negatively impact aerobic-exercise performance, which may interfere with compliance. Also, beta blockers are prohibited in some sports, e.g. archery and shooting, where control of tremor is seeked. Diuretics are banned at all times and in all sports, since they may mask performance-enhancing drugs.

Recommendations For Competitive Sports – Summarized in Fig 1
1. Low- or moderate-cardiovascular risk: No restrictions apply. If BP values are not normalized, temporary restriction from competitive sport is recommended, with possible exception of skill disciplines.
2. High-risk or very high-risk in whom control of BP has been achieved - participation in all competitive sports is possible, with the exception of power disciplines (Figures 1 and 2). If BP values are not well controlled, temporary restriction from competitive sport is recommended.

Recommendations For Recreational Sport Activities
Regular exercise training has been shown to reduce morbidity and mortality and is thus a Class IA indication. Patients are advised to perform at least 30 min of moderate-intensity, preferably (but not exclusively) aerobic-exercise training, 5–7 days per week. In patients with low- or moderate cardiovascular risk high-intensity exercises can be performed, even if common but arbitrary cut-offs, e.g. systolic BP ≥240 mmHg, are exceeded during peak intervals.



Legend: ACC = associated clinical condition; TOD: target organ damage.

Figure 1
(adapted from Recommendations for Participation in Competitive Sports of Athletes With Arterial Hypertension: A Position Statement From the Sports Cardiology Section of the European Association of Preventative Cardiology (EAPC). Eur Heart J 2018;39:3664-3671)

By **Dr. Rohit Khurana**
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ARRHYTHMIA

ARRHYTHMIAS IN ATHLETES

Arrhythmias are not uncommon in athletes. Whilst most are usually benign, some can be more dangerous and require further assessment and treatment. Marked sinus bradycardia and Mobitz type I heart block (also known as Wenckebach block) are common and usually due to a high vagal tone. A resting 12-lead ECG would be useful to document the PR interval and check that there are no other repolarization abnormalities present. They do not usually require any specific treatment unless the athlete is symptomatic, in which case further cardiac testing (e.g. with an echocardiogram, 24 hour Holter monitor and exercise treadmill test) may be required. Higher grades of heart block, including Mobitz type II and complete heart block, are abnormal in any individual, including athletes, and usually require further specialist evaluation and treatment with a permanent pacemaker.

Perhaps the most common abnormal arrhythmia in the athlete is atrial fibrillation (AF). AF in athletes is different from other types of AF affecting older patients with heart disease (e.g. cardiomyopathy, ischaemic heart disease, sinus node dysfunction) – the pathology is related to the high vagal tone and often preceded by an atrial tachycardia originating from one of the pulmonary veins. Most athletes are reluctant to take anti-arrhythmic medication for fear of side effects which may impair their exercise performance. Hence catheter ablation of AF (using the technique of pulmonary vein isolation) is often preferred by athletes and can be highly effective in this subgroup. Atrial flutter is different from AF in that it involves a macro-reentrant circuit around the right atrium (rather than multiple fibrillatory circuits in the left atrium in AF). Although different from and less common than AF, patients can be highly symptomatic. Again, catheter ablation of atrial flutter in athletes can be very effective and curative, avoiding the need for long term anti-arrhythmic medication.

Other types of supraventricular tachycardias (SVTs) seen in athletes include AVNRT and AVRT- both can cause intermittent fast palpitations with sudden onset and offset and be associated with impaired performance and dizziness. A resting 12-lead ECG should be performed to look for the presence of delta-waves which would point to a likely diagnosis of Wolff-Parkinson-White (WPW) syndrome if present. Even if the resting 12-lead ECG is completely normal, the arrhythmia could still have been a SVT (either AVNRT or a concealed accessory pathway). It is important to try to document the arrhythmia during the time of the palpitations to confirm the diagnosis. Use of longer term cardiac event monitors (see diagram), which can be loaned out to patients for up to several months, can be very useful in such cases and give a higher diagnostic yield than conventional 24 hour Holter monitoring. Once confirmed, the treatment of SVTs include observation only (if very infrequent and not too disabling), regular anti-arrhythmic medication (such as a beta-blocker or calcium channel antagonist) or catheter ablation (which has a high success rate of over 95% in curing SVTs).

Benign ventricular ectopics are commonly detected in athletes as part of a routine medical check-up and usually do not require any specific treatment if infrequent and asymptomatic. However, ventricular arrhythmias may potentially be more dangerous if the person experiences symptoms, such as dizziness or pre-syncope, or they have an abnormal resting 12-lead ECG. In such cases, further cardiac evaluation is important, including performing an echocardiogram and cardiac monitoring. An exercise treadmill test would also be useful in symptomatic individuals to look for the presence of exercise induced ventricular arrhythmias which makes the presence of an underlying cardiac abnormality (e.g. hypertrophic cardiomyopathy, inherited arrhythmogenic diseases) more likely. Severe life-threatening ventricular arrhythmias in athletes may require insertion of an implantable cardioverter defibrillator and the recommendation for the athlete to cease participation in competitive sports.

Practical tips for the primary care physician: The presence of asymptomatic sinus bradycardia, Mobitz type I heart block and benign atrial and ventricular ectopics on the 12-lead ECG in athletes are common and usually do not require any specific treatment. Athletes should be referred for further cardiac evaluation in the following situations:

- Their resting 12-lead ECG is abnormal (other than the benign types listed above), e.g. the presence of ventricular pre-excitation (delta wave), long QT syndrome, repolarization abnormalities
- They experience troublesome symptoms, e.g. frequent palpitations, dizziness, syncope or pre-syncope
- The athlete has a family history of sudden death or unexplained death below the age of 40 years in a first degree relative.

Figure- Mobile cardiac event recorder (e.g. Kardia device) used to detect intermittent arrhythmias. Patients press the device with their fingers or thumbs for about 30 seconds during an arrhythmic episode. The recording can then be emailed to the doctor's clinic for analysis.

By **Dr. Reginald Liew**
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CPET

CARDIOPULMONARY EXERCISE TESTING - WHEN SHOULD IT BE CONSIDERED?

Who is it for? Stress testing is often performed to rule out ischaemic heart disease using e.g. exercise ECG or stress echo. Cardiopulmonary exercise testing (CPET) provides a more comprehensive analysis and is useful in a range of different clinical scenarios. One commonly encountered group is patients with unexplained shortness of breath or loss of effort tolerance. Such symptoms can be especially challenging in patients with heart disease, as they often also have concomitant lung disease, and vice versa. CPET provides an objective measure of the exercise capacity of these patients, and identifies whether their limitation is due to the lungs or the heart. Other areas where CPET is widely used is to guide exercise prescription, both in patients at cardiovascular risk (e.g. overweight or diabetes) and in the presence of established cardiac disease (e.g. angina pectoris, heart failure, or after myocardial infarction). Clinical practice guidelines therefore recommend CPET strongly, describing it as 'valuable' and 'underused' in patients such as these, (Guazzi Circ 2016;133:e694-e711) and propose CPET as the gold standard for exercise prescription. (Mezzani Eur J Prev Cardiol 2013;20:442-67) A smaller group that may benefit from 'off-label' use is healthy athletes who are keen to improve their performance. The detailed characterisation of cardiopulmonary function that CPET gives can help to ensure training is optimal.

How is it done? While CPET can be done on a conventional treadmill test machine, it differs from standard stress tests in several important ways. During the test, continuous analysis of respiratory gas exchange is performed using a non-rebreathing valve connected to a mouth piece. Data on oxygen uptake (VO2) and carbon dioxide output (VCO2) are combined with workload and heart rate to derive an integrated analysis of cardiopulmonary function. During early exercise at low workload, aerobic metabolism predominates and lactate production is minimal. Once the load is high enough that the metabolic requirement of the exercising muscle begins to exceed the oxygen supply, the metabolism has reached the so-called anaerobic threshold (AT). Above this point, the exercising muscle produces lactate, which combines with the bicarbonate buffer in the blood to form hydrogen ions and carbon dioxide. One way to identify the AT is therefore that more carbon dioxide is exhaled above this point: VCO2 begins to rise compared to VO2. When the patient reaches exhaustion and the test ends, the highest achieved VO2 represents the maximal exercise capacity of the individual.

Why is it useful? Maximal VO2 is determined by pulmonary gas exchange, cardiovascular function and blood circulation, as well as skeletal muscle function. While a healthy person is typically not able to exercise to the upper limit of their pulmonary system, and the cardiovascular system sets the limitation, patients whose maximal VO2 is reduced due to a non-cardiac cause (e.g. lung disease) commonly do not reach AT before exhaustion occurs. When it comes to making an exercise prescription, the target level of exercise is often based on some measure of heart rate. This works under the assumptions that (i) an individual's maximal heart rate is a simple function of age (e.g. 220 - age), and that (ii) heart rate is closely correlated to gas exchange. One or both of these assumptions are often violated. (Tanaka JACC 2001;37:153-6) On the contrary, when CPET is used to design an exercise prescription, it is based on a direct, objective measure of the person's AT, which allows for a precise and individualised target to be set. In both patients and athletes, the rationale is that exercise is safer and better sustained when the intensity is kept at the aerobic steady-state below the AT. (Burnley Eur J Sport Sci 2007;7:63-79) The training zones determined by CPET using AT can be converted to target heart rates if heart rate monitors are worn during exercise. In the case of athletes, best performance will be achieved if they compete just below their AT, but train just above.

Conclusion - Stress testing with CPET is an underused and valuable method in a range of conditions. A commonly encountered group is patients complaining of shortness of breath and loss of stamina, where it differentiates a cardiac limitation from a non-cardiac. CPET also represents the gold standard method for making an exercise prescription especially in patients with heart disease or at high cardiovascular risk, but also in athletes who seek to optimise training.

By **Dr. Anders Sahlén**
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VASCULAR DISORDERS

VASCULAR DISORDERS IN THE ATHLETE

Athletes rarely present with symptoms or clinical findings suggestive of vascular disease. Those who exercise regularly, particularly marathoners, regular cyclists, triathletes and gym enthusiasts often consider themselves immune from peripheral vascular disorders. Any niggle or limb pain in the iron man competitor is considered to be of musculo-skeletal origin and keeps the physiotherapist and the orthopaedic specialists busy. However, vascular aetiologies should be considered when an athlete complains of persistent symptoms which are refractory to conservative therapies commonly used for presumed musculoskeletal injuries. This article focusses on vascular conditions that are unique to the fitness enthusiast and are often a cause of impaired athletic performance at best, and potentially serious pathology if missed.

Entrapment syndromes

These occur at a variety of sites and may be due to either aberrant fibro-muscular slips around joints or hypertrophic musculature in one of normal anatomy. Arteries and veins can be trapped within narrow spaces leading to vessel compression and chronic thrombo-fibrosis or even acute ischemia with threatened loss of limb.

Popliteal entrapment syndrome refers to the compression of the popliteal artery by the surrounding musculo-tendinous structures; primarily by an extra musculotendinous slip coming off the of the gastrocnemius muscle. It affects young patients who are otherwise healthy, and can be debilitating. The most common activities associated with popliteal entrapment include basketball, football, rugby, and the martial arts. Patients are typically young (60% are less than 30 years of age) and male (15:1 male predilection). The condition can be bilateral in 25% of cases. Although there is no clear evidence that popliteal entrapment is more common in the athletic population, it is likely more commonly unmasked in athletes due to the presence of hypertrophied gastrocnemius muscles and higher demands on the lower extremity circulation (Fig 1, Fig 2). Treatment consists of confirming the diagnosis by cessation of Doppler flow on hyperextension of the knee, identifying the slip on MRI and surgical division of the aberrant muscle slip to release the arterial compression.

Adductor canal syndrome occurs due to the compression of the superficial femoral artery in the middle third of the adductor canal. The adductor canal, or Hunter's canal, is an aponeurotic tunnel bordered by the vastus medialis muscle antero-laterally, adductor longus and magnus muscles posteriorly, and sartorius muscle medially. The superficial femoral artery may be compressed by a surrounding hypertrophied muscle or an anomalous musculotendinous band. It is most commonly reported in runners and skiers, who present with exercise-induced intermittent claudication symptoms and paraesthesia. Symptoms are typically chronic and progressive, although dissection and thrombosis of the superficial femoral artery can occur, resulting in complete occlusion and a more acute presentation. Exercise ABI studies may be required in addition to Duplex ultrasonography and MRI scanning to clinch the diagnosis. Treatment includes surgical resection of anomalous musculoterdinous bands, in addition to a vein patch angioplasty or bypass of the affected arterial segment. Patients presenting with acute arterial occlusion require immediate surgical revascularization.

Iliac artery endofibrosis

External iliac artery endofibrosis is one of the most commonly described lower extremity vascular conditions in competitive athletes. The disease is defined as intimal thickening of the external iliac artery with collagen fibres, fibroblasts and smooth muscle cells, in the absence of inflammatory or atherosclerotic lesions. The external iliac artery is the most commonly affected artery, occurring in 90% of cases, with the common iliac and/or common femoral artery rarely affected. The condition more commonly affects the non-dominant limb. Cyclists are affected most frequently, although the condition is also seen in long-distance runners, triathletes, rowers and cross-country skiers. Patients present at a mean age of 25 years. The condition has been reported in competitive cyclists who average 8000–35,000 km per year, or about 150,000 km in a lifetime.

The proposed pathophysiology of this disease relates to the mechanical stress placed on the external iliac artery due to the extreme hip flexion in combination with the shear stress during high cardiac output states. Athletes typically present with an unexplained decline in performance, leg weakness and a lack of power in the affected leg. Symptoms are usually unilateral, although can be bilateral in 15% of cases. In addition to non-invasive vascular testing, an angiography and intravascular ultrasound are essential to ascertain the severity and extent of the arterial fibrosis. Percutaneous trans-luminal balloon angioplasty is often sufficient to treat the condition, though in severe cases, surgical release of the artery from encasing fibrotic tissue and a surgical vein patch angioplasty may be required. Stents are not usually used in this scenario due to the high propensity for stent fractures and acute thrombosis in them.

Chronic exertional compartment syndrome (CECS)

CECS is defined as transient limb ischemia secondary to a non-compliant osseo fascial muscular compartment that is unable to accommodate muscle volume expansion during exercise. It is very common in athletes, accounting for up to 75% of sports-related chronic lower extremity pain. Most commonly affected are long-distance runners, although CECS has been reported in skiers and in soccer, rugby, basketball and tennis players. The condition tends to be precipitated by activities that require weight-bearing and constant pounding of the feet and lower legs on unforgiving surfaces. Patients typically complain of a cramping, aching pain or tightness in the anterior or lateral calf that occurs at a predictable, well-defined point of activity, which dissipates with activity cessation. If the anterior compartment is involved, patients can display weakness during dorsiflexion, paraesthesia on the dorsum of the foot, numbness within the first web space and foot drop. Treatment consists of a limited anterior or lateral fasciotomy and immediate range of motion exercises to prevent scar tissue formation. A full recovery to competitive activity usually occurs within 10-12 weeks.

Vascular disorders should be considered in those who undertake endurance sporting activity especially when refractory to normal orthopaedic and physiotherapy inquisition. A comprehensive history should be taken, with special consideration to the postures the athlete assumes repeatedly during their chosen sport. Musculoskeletal anatomy surrounding the vascular bed of interest should be thoroughly reviewed. Physical examination should include provocative manoeuvres specific to the suspected vascular disorder. The proper use of non-invasive diagnostic studies, including duplex ultrasonography, computerized tomography (CT), and magnetic resonance imaging (MRI), along with catheter-based angiography and intravascular ultrasound, when indicated, can ensure prompt diagnosis. Appropriate, multifaceted treatment of an athlete affected by a vascular disorder can facilitate an expeditious return to previous levels of activity.

Figure 1. MRI of knee in popliteal artery entrapment syndrome. (arrow points to aberrant musculotendinous slip wrapping around the popliteal artery)

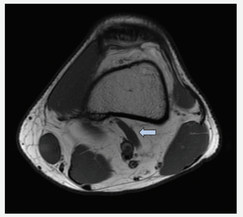
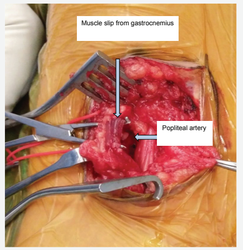


Figure 2. Operative image of musculotendinous slip in popliteal artery entrapment



By **Dr. Sriram Narayanan**

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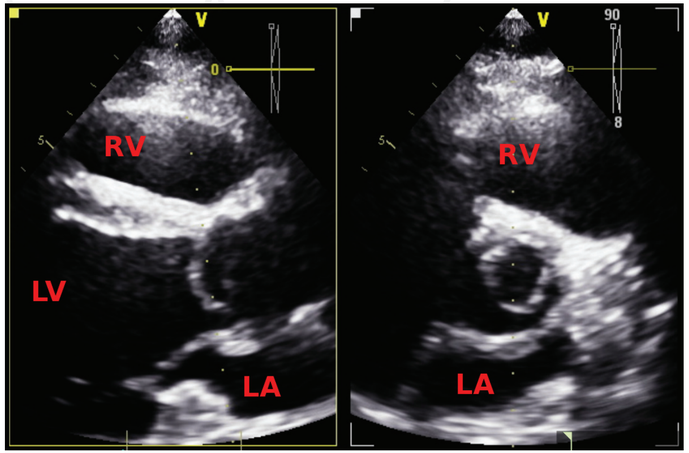
ECHO QUIZ

A 24-year-old male patient sees you for exertional chest tightness. He is known to have a murmur since childhood. A transthoracic echo is arranged. The figure shows parasternal images obtained using 3-dimensional acquision: long-axis view (left panel) with a perpendicular plane placed across the image, and the corresponding short-axis view (right panel). LV denotes left ventricle; RV, right ventricle; LA, left atrium.



Questions:

Which of the following are true?

1. An anomalous coronary artery should be excluded.
2. This patient is at elevated risk of a thoracic aortic aneurysm.
3. Cascade screening in first-degree family members should be considered.
4. This condition is twice as common in males as in females.
5. All of the above are correct.

Answer is available on our website:
http://www.harleystreet.sg/quiz-answers/medbulletin-march-2019/

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MEDBULLETIN MARCH2019

THE HARLEY STREET HEART & VASCULAR CENTRE

INTRODUCTION

Welcome to the 10th edition of our Harley Street newsletter in which our specialists aim to provide the busy clinician with succinct updates and practical tips on the latest issues relating to specific cardiovascular disorders. The focus of this edition is on the assessment and management of cardiovascular disorders in athletes. Doctors are increasingly seeing patients in clinic who engage in competitive and strenuous physical activities and sports. Some of these individuals may present to their primary care doctor with vague symptoms which may be related to an underlying cardiovascular disorder or be found to have an abnormality, such as high blood pressure or resting ECG changes, at a routine medical check-up.

In this newsletter we cover the following important topics: Dr. Khurana provides an update on the management of hypertension in athletes, highlighting the latest recommendations from international guidelines and practical lifestyle advice we should be giving to such patients. Dr. Liew has written a summary article on commonly encountered arrhythmias in athletes- some of these are benign and do not require any specific treatment, whilst others are more sinister and require further evaluation, medical therapy and/ or catheter ablation. We are pleased to be able to introduce Dr. Anders Sahlen who has recently joined the Harley Street team. Dr. Sahlen is a highly trained and internationally recognized cardiologist with a sub-speciality interest in non-invasive imaging and sports cardiology. He brings a wealth of new experience to the team and provides an overview of the cardiopulmonary exercise test and how it can be used clinically in the assessment of individuals and athletes with a suspected cardiopulmonary limitation. Finally, Dr. Sriram Narayanan shares his experience and knowledge on the important field of vascular disorders in athletes.

As with previous editions, we have included a short practical quiz at the end of the newsletter which is aimed to stimulate the reader but also provide practical and useful information. The answer to the quiz can be found on our website after publication of the newsletter (http://www.harleystreet.sg/quiz-answers/medbulletin-march-2019). We hope you enjoy reading the newsletter and welcome your feedback or suggestions for future editions.

Happy reading!

From The Harley Street Heart & Vascular Centre

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