What I tell my patients about renovascular disease

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Renovascular disease (also known as renal artery stenosis) describes the narrowing of the main blood vessels (renal arteries) which supply the kidneys (Figure 1). This can lead to a decreased flow of blood to the kidneys. With recent advances in the screening and diagnostic tests available for this condition, renovascular disease is now recognised to be a common cause of impaired kidney function (renal failure) and high blood pressure (hypertension). There are two main types of renovascular disease: atheromatous renovascular disease (ARVD) and fibromuscular dysplasia (FMD).

What are the renal arteries and what do they do?

Most people have two kidneys, weighing a total of 300–400 g, which receive about 20% of the total blood flow through the body every minute. In most people, a single renal artery arising from the aorta (the body's main blood vessel) supplies each kidney, although in a few cases one or both kidneys may be supplied by more than one artery.

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High renal blood flow is essential for the kidneys to perform their major functions – to filter the blood and remove any extra salt and water to prevent fluid from building up in the body and leading to hypertension, leg swelling (oedema) or the accumulation of fluid on the lungs (pulmonary oedema). Getting rid of various toxic substances, whether produced by the body's metabolism or ingested with food, also depends on a high blood flow to the kidneys. A reduced blood flow will reduce the filtration ability of the kidneys and cause a build-up of toxic substances in the body. This is known as renal (kidney) failure.

What are the different types of renovascular disease?

ARVD

This is by far the most common type of renovascular disease. It is mostly seen in older patients and is rare in those under the age of 45 years. The narrowing of the renal artery results from atherosclerosis (Figure 2). Atherosclerosis is the result of inflammation and build-up of cholesterol crystals in the wall of the artery, causing a gradual narrowing of the blood vessel. This process can affect any of the major arteries in the body. Patients with ARVD also tend to develop atherosclerosis in other major blood vessels, such as those to the heart (coronary artery disease; CAD), legs (peripheral vascular disease; PVD) and the brain (cerebrovascular disease; CVD). The most common risk factors for atherosclerosis include age, male sex, high blood pressure, smoking, high blood cholesterol (hypercholesterolaemia), diabetes mellitus and a family history of the disease.

FMD

This is a rare cause of renovascular disease (accounting for less than 1% of all cases) that

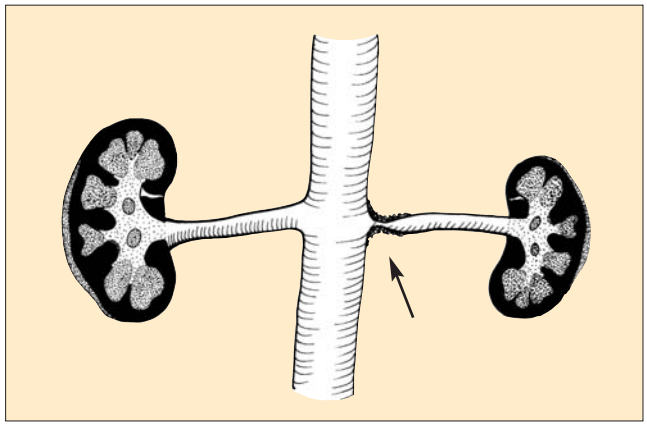

Figure 1. *Schematic diagram of left renal artery stenosis (arrowed) supplying a slightly smaller left kidney*

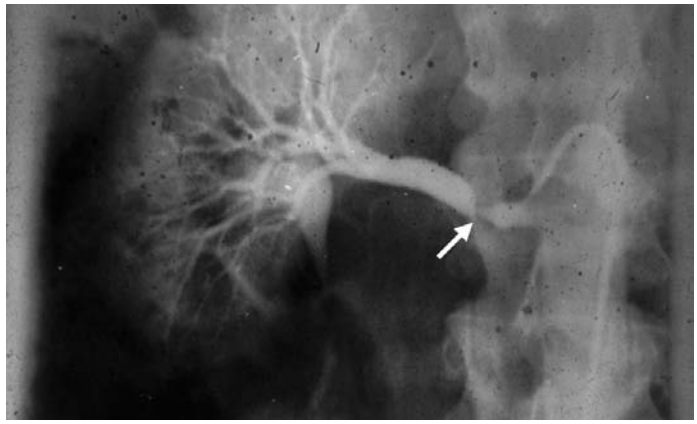

Figure 2. *Renal angiogram showing atherosclerotic stenosis of the right renal artery (arrowed)*

occurs at a younger age (20–30 years). It is more common in women, who usually first approach their doctor with unexplained hypertension. In a few patients, there can be associated narrowing in other arteries in the body, especially the aorta and the carotid arteries (arteries located on either side of the neck that carry blood from the heart to the brain). The exact cause of FMD is unknown but the narrowing of the renal arteries is due to a thickening of the muscular wall of the vessels (Figure 3).

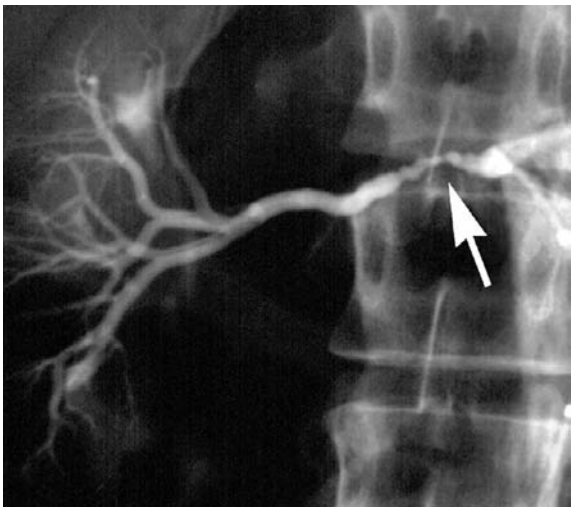

Figure 3. *Renal angiogram showing fibromuscular dysplasia of the right renal artery. The appearance is described as a 'string of beads' (arrowed)*

How do you suspect that a patient might have renovascular disease?

There are several clues that can arouse suspicion of ARVD (Table 1), any or all of which can be present in a patient. The presence of non-renal atherosclerosis (CAD, PVD and/or CVD), vascular bruits (noise, heard with a stethoscope, caused by turbulent blood flow in narrowed major arteries), or a significant difference (over 1.5 cm) between the sizes of the two kidneys when scanned by ultrasound are all important signs. However, an increasing number of patients are being incidentally shown to have ARVD during investigation for other vascular disease (mostly for CAD and PVD). Some of these patients have normal blood pressure and kidney function – so the significance of their ARVD is not fully understood.

Several clues can arouse suspicion of ARVD, any or all of which can be present

In FMD, the most common clue is high blood pressure that may be difficult to control on medication, since kidney function may not be affected. A diagnosis of FMD often relies on a high degree of suspicion on the part of the doctor – especially in cases of severe hypertension in young women who have no family history of high blood pressure.

How is renovascular disease diagnosed?

There are several tests available for the screening and diagnosis of renovascular disease. The gold standard diagnostic test is intra-arterial angiography, which is a procedure that involves inserting a catheter into the femoral artery (the main artery in the groin) to the level of the renal arteries. Dye is injected and a series of images taken to visualise the renal arteries (see *Having a renal angiogram,* page 17).

Most of the other available tests are less accurate, but carry a lower risk of complications. Table 2 describes these investigations with their respective advantages and disadvantages. The safest screening tests are magnetic resonance angiography (MRA) and Doppler ultrasound, but the choice varies depending on the availability of the test and the local expertise in different centres.

Patients with suspected renovascular disease usually first undergo a non-invasive screening test (usually with MRA, Doppler or by CT scan), which enables the diagnosis of renovascular disease to be made. Intra-arterial angiography, which is a more invasive procedure, can then be reserved for assessment of the severity of the arterial narrowing, and this is often performed with the intention of proceeding to angioplasty straight after the angiogram.

Table 1. Possible symptoms and signs of ARVD

- Hypertension
- Accelerated hypertension (rapidly worsening blood pressure) with evidence of damage to the kidney, brain or other organs
- Chronic renal failure or end-stage renal failure requiring dialysis
- Recurrent episodes of shortness of breath resulting from fluid accumulation on the lungs (pulmonary oedema)
- Acute deterioration of the kidney function after commencing particular blood pressure drugs (angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers)
- ARVD may be silent (asymptomatic)

Table 2. Tests available for screening patients for renovascular disease

Test	Advantages	Disadvantages
Captopril renography	● Non-invasive ● No contrast used (certain radiographic contrast agents may lead to temporary, but fully reversible damage to the kidneys (nephrotoxicity)	● Only gives indirect evidence for the presence of renovascular disease ● Not sensitive enough for patients with impaired kidney function
Computerised tomography (CT) angiography	● Non-invasive ● Gives good quality images of the kidneys and the arteries	● Uses a nephrotoxic contrast agent
Magnetic resonance angiography (MRA)	● Non-invasive ● No nephrotoxic contrast agent used ● Gives very good quality images of the kidneys and the renal arteries ● Being developed for the assessment of kidney function	● Space in the scanner is enclosed (may be difficult to scan patients with claustrophobia) ● May overestimate the degree of the arterial narrowing
Ultrasound Doppler scan	● Non-invasive ● No contrast used at all ● May help to predict the response of blood pressure to angioplasty	● No images of the arteries ● Not available at all units ● Time-consuming
Intravenous digital subtraction angiography (IV-DSA)	● Non-invasive	● Uses a nephrotoxic contrast agent ● Poor quality images (rarely used at present time)

Can the narrowing in the renal arteries be opened up?

The narrowing in the renal artery can be opened up by one of two main types of procedure. This is called renal revascularisation. The two options are:

- Renal angioplasty, with or without stent insertion (where a metal or plastic tube is inserted into the vessel to keep it open and prevent closure)
- Surgical reconstruction of the renal artery or bypass surgery.

The surgical option is very invasive and is usually reserved for patients with complicated conditions, such as those with disease in the aorta. Renal angioplasty is a much less invasive option for restoring the openness (patency) of the renal artery and is usually the first choice treatment for ARVD (see *Having a renal angiogram*).

Are there any complications associated with renal revascularisation?

Surgical treatment requires a fairly large operation and general anaesthetic and, as patients with ARVD often have linked coronary and cerebrovascular disease, there is a chance of serious complications in about 10% of cases. Angioplasty can also be linked to complications, the most common of which is bleeding from the puncture site; this can be easily treated. There can be a mild deterioration of kidney function due to the contrast dye, which can be toxic to the kidney (called 'contrast nephropathy'). This occurs in about 5% of cases but is reversible. More serious complications, such as the complete blockage or even rupture of the renal artery, are rare (occurring in about 1% of cases).

Is there any other treatment available for renovascular disease?

ARVD is part of a process that also tends to affect other blood vessels and major organs. It is therefore important to protect the blood vessels and organs from worsening disease. Treatments used to achieve this include:

- Control of the blood pressure using tablets (antihypertensive medication) to avoid the complications of hypertension, which include eye (retinal) damage, further blood vessel damage, and thickening of the heart muscle (ventricular hypertrophy)
- Use of aspirin (and/or other similar drugs) to prevent the build-up of platelets (small cells in the bloodstream responsible for the formation of blood clots)
- Use of cholesterol-lowering drugs (statins) to lower serum cholesterol.

What would happen if I had no treatment for ARVD?

Many patients fare well with the medical therapy described above, without having to undergo revascularisation. However, in some people, other problems (such as worsening kidney function, blood pressure or heart disease) can eventually arise despite medical therapy. There is evidence that very tight narrowing of the renal artery (over 75% narrowing) can sometimes lead to a complete blockage of the artery, with complete loss of function in that kidney. This seems to occur particularly in patients who receive no medical therapy.

I have FMD affecting the kidneys. Should I undergo revascularisation?

Patients with FMD tend to benefit from revascularisation, and their blood pressure and renal function usually improve. The most common revascularisation technique used in these patients is renal angioplasty. Stents are not commonly used, as they have not been well studied in this minority group of patients. Unfortunately, the nature of FMD is that it tends to recur either at the same site in the renal artery, or at different sites (in 5–10% of cases). For this reason, all patients must have their blood pressure regularly checked in order to detect any recurrence. In a few cases, angioplasty may be technically difficult so surgery will be needed to restore the openness of the renal artery.

It is uncertain which patients with ARVD will benefit most from revascularisation

What is the best treatment for ARVD?

At the present time, we are uncertain how to select those patients who will benefit most from revascularisation. Although the openness (patency) of the renal artery can be restored in over 95% of cases, the outcome for blood pressure and kidney function is less satisfactory. Angioplasty will improve blood pressure in about half of patients, but a 'cure' for hypertension, resulting in patients no longer needing antihypertensive medication, is rarely seen. With regard to kidney function, about 25% of patients show some improvement after angioplasty, 50% remain unchanged, and up to 25% continue to have deteriorating renal function. A small number of patients lose renal function as a direct result of the angioplasty and stenting procedure.

We now believe that this variation in the response of blood pressure and kidney function to revascularisation is partly related to disease affecting the small blood vessels within the kidney (intrarenal vascular disease) and to disease affecting the kidney tissue itself (renal parenchymal disease). These small blood vessels in the kidneys cannot be seen using any of the imaging techniques currently available, and although information can be obtained from a biopsy of kidney tissue, this test is not routinely advocated for patients with renovascular disease. More research is needed to establish the importance of these blood vessels in ARVD.

The ASTRAL trial

The benefits of revascularisation are only clear in a small number of patients with ARVD – particularly those who are prone to developing sudden heart failure. In the vast majority of the remaining patients with ARVD there is no evidence as yet to show that revascularisation is better than medical treatment alone, and it should also be remembered that revascularisation itself is occasionally complicated by problems.

A large multicentre UK study called ASTRAL (**A**ngioplasty and **ST**enting in **R**enal **A**rtery **L**esions) is currently in progress. In this study, patients with ARVD give informed consent to be randomly assigned to either medical treatment alone or revascularisation (with medical treatment). They are then followed to monitor their progress and the changes in their renal function and blood pressure over time. It is hoped that this will shed some light on the usefulness of revascularisation versus medical treatment alone ■

Key points

- **Narrowing of the renal arteries can be due to atherosclerosis (ARVD), which is common, or fibromuscular dysplasia (FMD), which is rare.**
- **ARVD is commonly associated with disease in other major blood vessels, such as those to the heart, brain and legs.**
- **Medical treatment is important for ARVD, with particular focus on reducing blood pressure and cholesterol, and limiting further vascular disease.**
- **There is currently no clear evidence to guide which ARVD patients should be treated with revascularisation.**

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