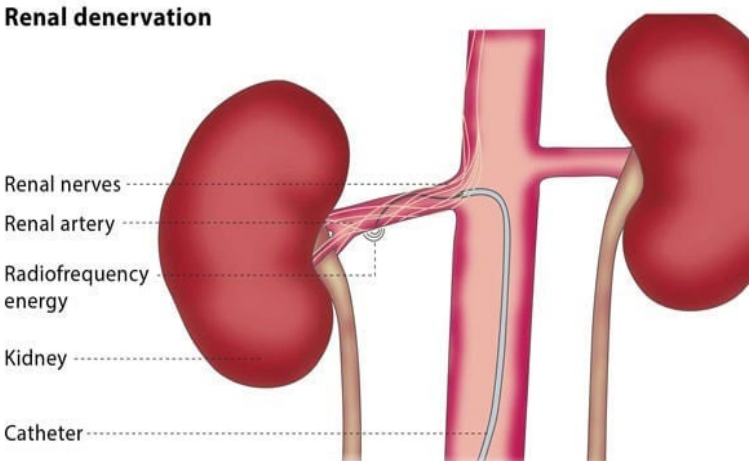
TEAM TALK

RENAL DENERVATION

Renal denervation (RDN) offers an innovative treatment for patients with hypertension that is not well controlled by medication. Patients experience lower blood pressure, reducing the risk of stroke, kidney disease and heart failure.

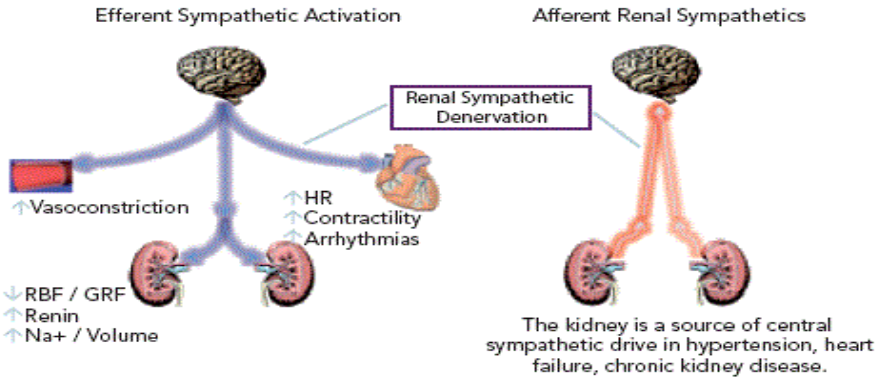
As a minimally invasive procedure with just a tiny incision, renal denervation involves a short hospital stay and people benefit from a quick recovery with less pain.

RDN is a minimally invasive catheter-based intervention that uses one out of a range of techniques to disrupt renal afferent and efferent nerve signals between the kidney and brain.



https://www.cirse.org/patients/general-information/ir-procedures/renal-

Figure 1: Efferent and Afferent Renal Sympathetic Activation



GFR = glomerular filtration rate; HR = heart rate; Na+ = sodium ion; RBF = renal blood flow. Modified from Sobotka, et al., 2011.[1]

https://www.radcliffecardiology.com/image-gallery/4210/8520/bohmfig1

The kidneys have a dense nerve supply, and previous studies have established the role of the sympathetic nervous system in regulating kidney function and BP.

Among patients with uncontrolled hypertension, sympathetic nervous system overdrive causes increased renal renin excretion, which results in increased blood volume and arterial tone. The afferent and efferent renal nerves travel in close proximity to the renal arteries in the perivascular adipose tissue.

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How is treatment delivered?

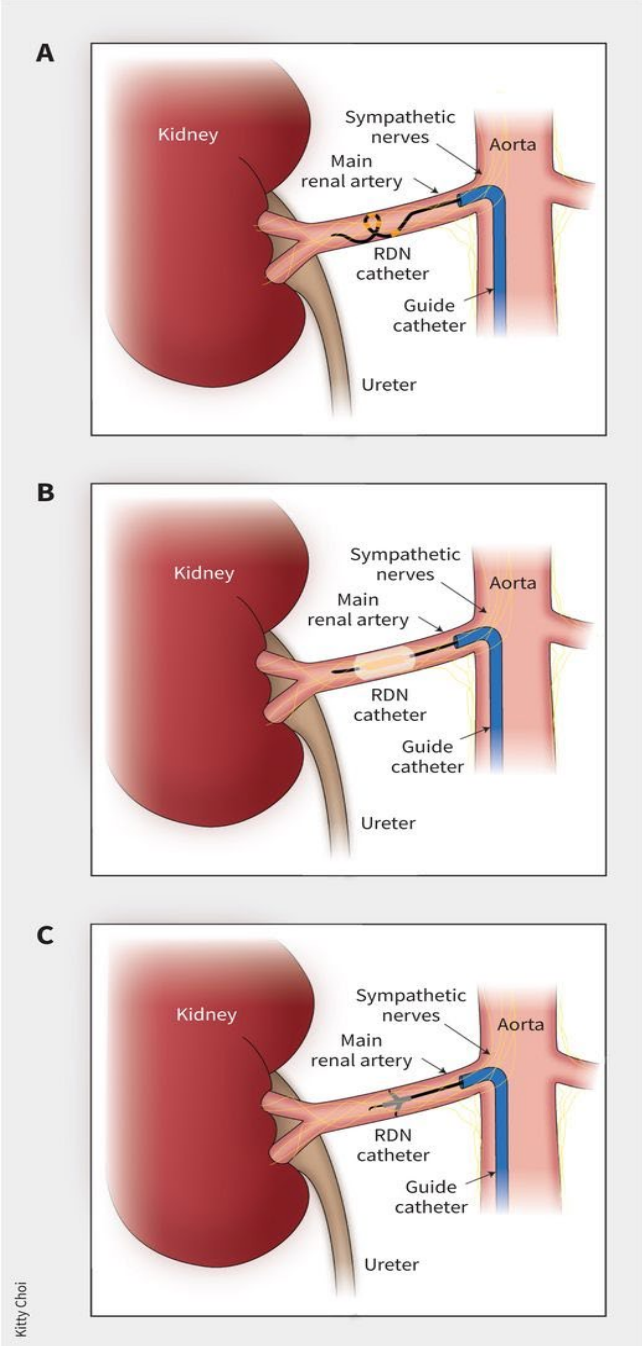
The procedure is performed by an experienced interventionalist under fluoroscopic guidance, typically in an interventional catheterization suite. With the patient under conscious sedation, the RDN catheter is advanced to the renal arteries via the common femoral artery and aorta.

Several RDN technologies exist:

- The multi-electrode RDN catheter (e.g., Medtronic) simultaneously delivers 60 seconds of **radiofrequency** energy to 4 gold electrodes in contact with the arterial wall in spiral configuration. To minimize thermal effects, the design permits continuous blood flow during energy delivery, ensuring both arterial and electrode cooling during treatment. All accessible renal arteries with a diameter of 3–8 mm, including branch vessels and accessory arteries, are treated.

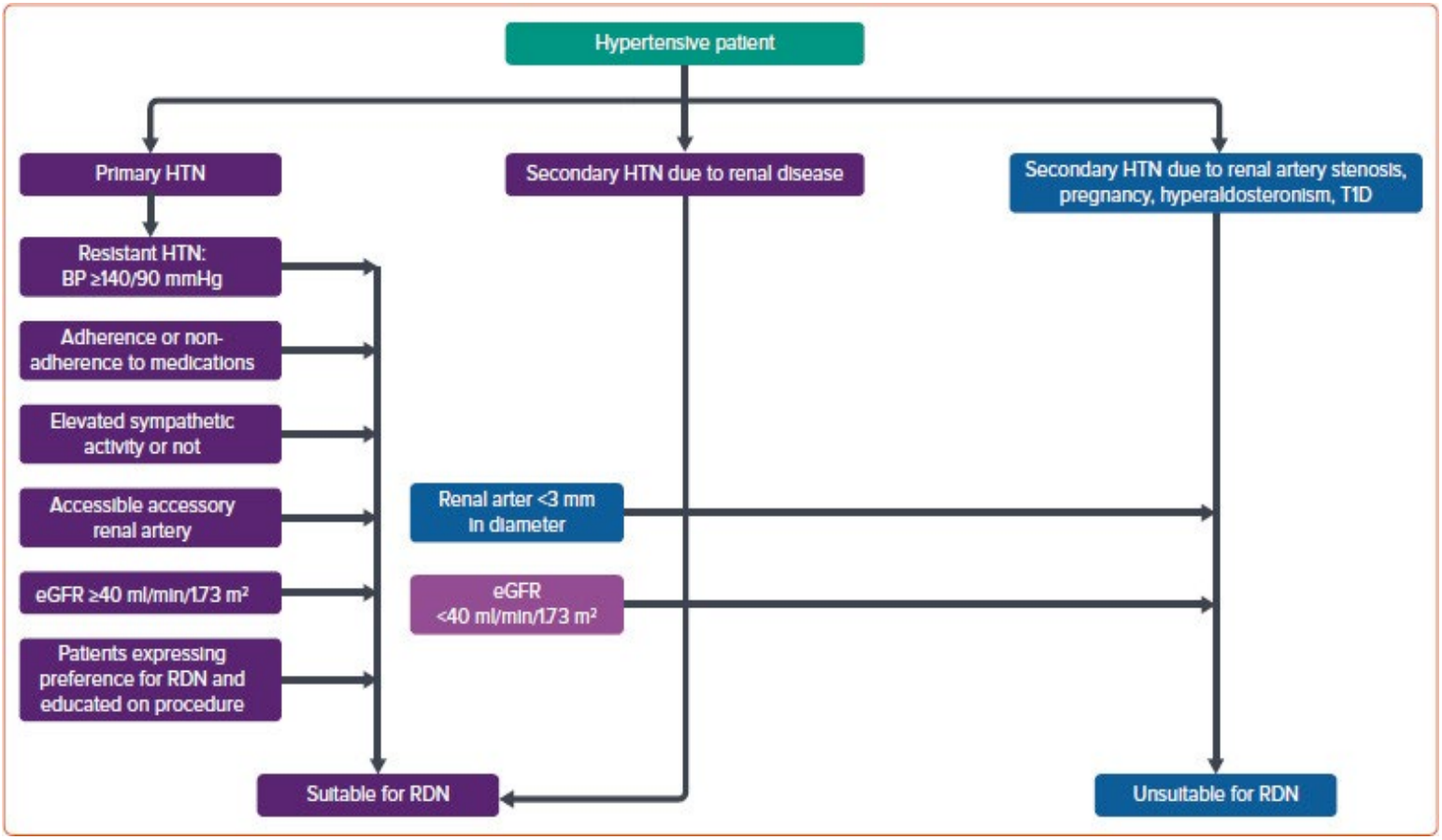
- The **ultrasound** RDN system (e.g., ReCor Medical) delivers ultrasound energy to thermally ablate the renal nerves. The catheter is positioned within the main renal arteries and centered by an integrated low-pressure, saline-filled cooling balloon to achieve a circumferential ring of ablation. Treatment is delivered sequentially to the distal, mid and proximal main renal arteries, with each treatment lasting 7 seconds.

- **Alcohol-based** RDN (e.g., Ablative Solutions) uses 3 retractable deep microneedles to deliver dehydrated alcohol into the perivascular space of the main and large accessory renal arteries (4–7 mm) causing nerve degeneration.



Circumferential ablation of renal sympathetic nerves by (A) multielectrode radiofrequency ablation, (B) ultrasound-based denervation or (C) alcohol-mediated perivascular renal denervation. Radiofrequency treatment is delivered bilaterally in a number of locations along the main and extra-parenchymal renal arteries ranging from 3 to 8 mm in diameter. For ultrasound-based or alcohol-mediated denervation, treatment is applied to both main renal arteries only.

Who may be eligible for RDN?

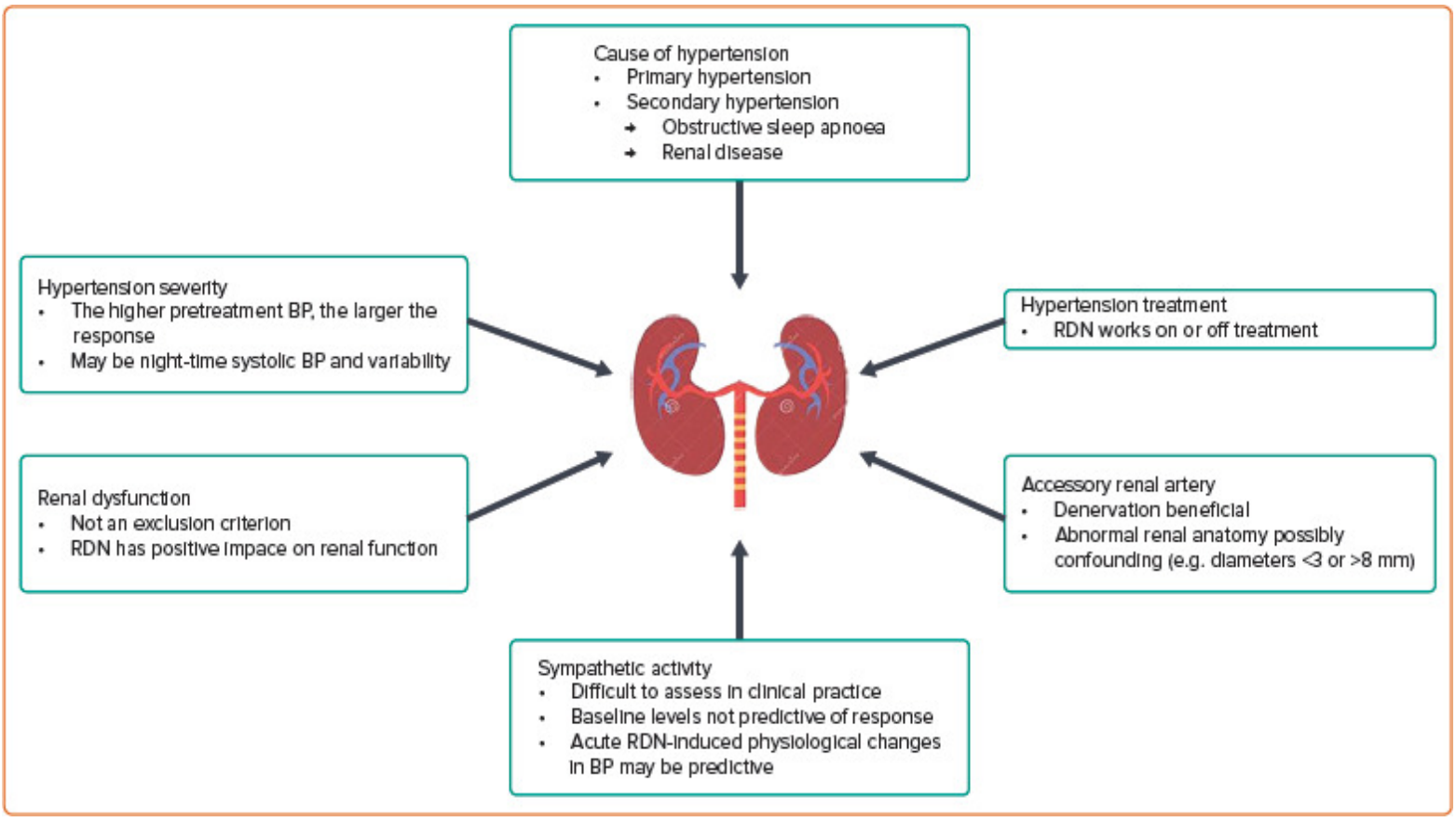


Key considerations for treating with RDN include uncontrolled hypertension (despite guideline-based therapy, including health behavior changes and 1–3 medications), elevated cardiovascular risk or end-organ damage (e.g., heart, kidney or brain damage, peripheral arterial disease); shared decision-making regarding risks, benefits, and circumstances affected by social determinants of health (e.g., low income, difficulty complying with complex medication regimens); and endorsement of candidacy by a hypertension expert and interventionalist.

Exclusion criteria used in clinical trials were renal fibromuscular dysplasia, renal artery stenosis greater than 50%, previous renal artery stenting within the last 3 months, an estimated glomerular filtration rate less than 40–45 mL/min/1.73 m2, a single functioning kidney and previous kidney transplantation.

In the absence of evidence, it is not advised to perform RDN (outside of studies) in patients:

- Whom are kidney transplant recipients
- With severely impaired kidney function
- Requiring hemodialysis
- With fibromuscular dysplasia
- With untreated secondary HTN
- With a single functioning kidney
- With HTN secondary to renal artery stenosis
- With a renal artery diameter <3 mm, and the presence of structural renal abnormalities need careful consideration for RDN – these factors could preclude proper ablation of the renal nerves and undermine the therapeutic effects of RDN



What are the resource implications?

Most RDN procedures will require about 1-2 hours of time in an interventional suite, RDN catheters, a console and standard equipment employed for percutaneous vascular access and renal interventions. Patients treated with RDN may be kept in hospital overnight for BP monitoring and adjustments to antihypertensive medications, as needed.

Accordingly, the following for pre-procedural imaging is recommended:

1. If invasive renal artery imaging is not an option, CT or magnetic resonance angiography (MRA) are preferential to duplex ultrasound.

2. Selective renal angiography immediately before RDN remains the gold standard because CT angiography or MRA may miss some renal artery abnormalities.

What are the complications?

Studies of RDN have not identified excess device- or procedure-related risks relative to sham-control patients. The procedural risks are mostly those associated with femoral arterial catheterization.

Complication	Incidence
Acute procedure-related complication	
Minor complications in vascular access site (e.g., small hematoma, bruising)	4%–5%
Major complication in vascular access site (e.g., large hematoma, retroperitoneal bleeding, arteriovenous fistula, pseudoaneurysm formation)	< 1%
Renovascular complication (e.g., renal artery dissection, distal perforation, intracapsular renal hematoma, de novo renal artery stenosis, aortic dissection)	< 1%
Acute kidney injury	< 1%
Late complication*	
Late de novo renal artery stenosis	0.2% per year
Worsening kidney function (i.e., change in eGFR and serum creatinine from baseline to 36 months)	No significant difference compared with sham-control patients

Outside of more general patient education on the relationship between HTN and CV outcomes, the following messages are essential to communicate to those considering RDN:

- RDN is equivalent to at least one potent medication.
- Patients are unlikely to become medication free.
- Patients should expect to see some reduction in BP by 2–3 months, but the effect improves over time.
- There are potential complications for any invasive procedure.

Additional Management Considerations for Those Undergoing Renal Denervation:

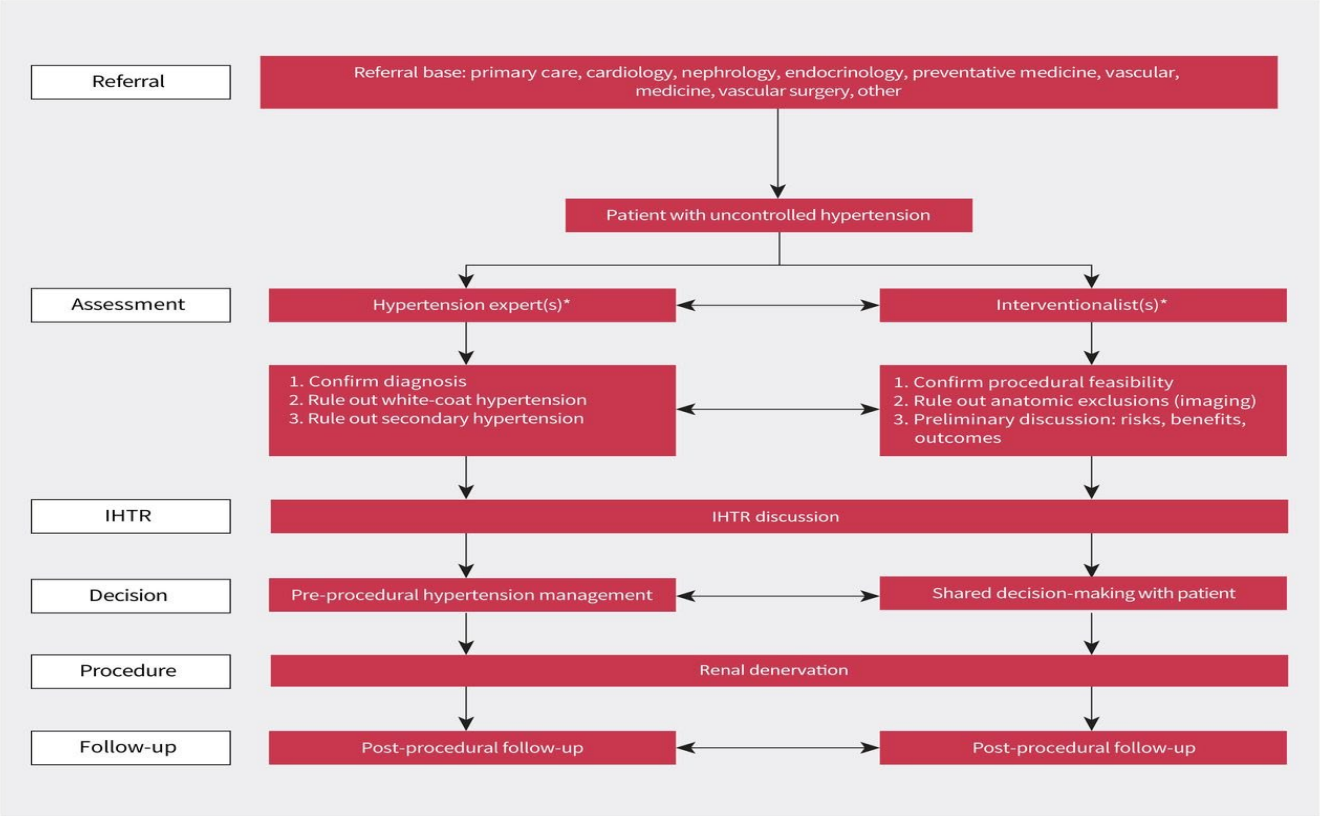
After the procedure, immediate care should mirror that for most other catheter-based interventions. As such, follow-up procedures should be as usual for hypertensive patients but incorporate imaging:

Immediately after RDN:

- Aspirin may be indicated
- Patients should be observed for groin access or other complications according to local practice for comparable procedures, and this may involve an overnight stay
- Patients should be encouraged to maintain their ongoing antihypertensive medication(s) unless they have signs of postural hypotension, in which case they should contact their physician.

Follow-up:

- Should occur at 1, 3, 6 and 12 months after the procedure and should be coordinated between the patient's general physician and the interventionalist/specialist
- Should monitor office and out-of-office BP to check for BP control, as well as potassium (general physician)
- Should include ultrasound imaging at 6 months and 1 year to check for renal stenosis (specialist)
- Should check drug adherence periodically (general physician and specialist)



Sources:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10433107/

https://www.cmaj.ca/content/195/43/E1475