

ULTRASOUND RENAL DENERVATION

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Ultrasound renal denervation (uRDN) is an emerging non-pharmacological, device-based therapy for the treatment of hypertension. It targets the renal sympathetic nerves, which are involved in blood pressure regulation, and offers a potential long-term intervention particularly for patients with resistant or poorly controlled hypertension despite optimal medical therapy.

Mechanism of Action

Renal sympathetic nerves play a key role in regulating blood pressure via modulation of renal blood flow, sodium retention, and renin release. Ultrasound renal denervation involves the use of a catheter-based system to deliver circumferential ultrasound energy to the renal arteries. This results in selective disruption of afferent and efferent sympathetic nerves located in the adventitia, thereby reducing sympathetic tone and its hypertensive effects.

Procedure and Pharmacokinetics

The procedure is performed via a percutaneous transfemoral approach under imaging guidance. The ultrasound catheter is advanced into each renal artery, and high-frequency ultrasound energy is delivered in a controlled, circumferential pattern. Unlike pharmacologic therapies, the effects are not subject to daily compliance, metabolism, or renal clearance, making uRDN particularly relevant for patients with issues of adherence or polypharmacy. The full antihypertensive effect may take weeks to months to manifest as sympathetic tone gradually reduces.

Evidence Base

Randomised controlled trials (e.g. RADIANCE-HTN SOLO, RADIANCE-HTN TRIO) have demonstrated statistically significant modest reductions in ambulatory and office systolic blood pressure with ultrasound RDN compared to sham control. Benefits have been observed both in patients not taking antihypertensives (off-med trials) and in those with resistant hypertension (on-med trials). Long-term data on cardiovascular outcomes is emerging but limited at present.

Adverse Effects

uRDN is generally well tolerated, with a low complication rate. Potential risks include:

- Vascular complications at the access site (e.g., haematoma, pseudoaneurysm)
- Renal artery injury or stenosis (rare)
- Contrast-induced nephropathy in patients with pre-existing kidney dysfunction

No significant impact on renal function has been observed in trial follow-ups to date.

Practical Issues

- **Patient Selection:** Ideal candidates are adults with confirmed uncontrolled hypertension (e.g., Systolic BP ≥ 140 mmHg or 24-hour ABPM ≥ 130 mmHg), especially those with poor adherence, medication intolerance, or preference for non-drug therapy.
- **Additional Tests Required:** Includes renal imaging to confirm suitable anatomy and exclusion of secondary causes of hypertension.
- **Availability:** Currently limited to specialised centres with appropriate expertise; cost-effectiveness and commissioning decisions vary by region.
- **Post-procedural Monitoring:** Blood pressure monitoring should continue as effect onset is gradual. Some patients may still require adjunctive medications.

Current Role in Guidelines

While not yet mainstream in NICE or ESC guidelines, ultrasound RDN is increasingly recognised as a potential adjunctive therapy in resistant hypertension. Ongoing studies and registry data will further define its place in therapy.

Note: uRDN should be considered only in appropriately selected patients, preferably within the context of a multidisciplinary hypertension service or clinical trial setting.