Newer Modalities in Hypertension Treatment

In addition to newer antihypertensive drugs, several **innovative treatment approaches** are emerging for managing **resistant and difficult-to-control hypertension**. These include **device-based therapies, gene therapy, and advanced digital health technologies**.

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1. Renal Denervation Therapy (RDN)

- **Mechanism:** Uses **radiofrequency (RF), ultrasound, or chemical ablation** to disrupt **renal sympathetic nerves**, reducing overactivity that contributes to high BP.
- **Methods:**
  - **Radiofrequency Ablation** – Delivers heat energy via a catheter.
  - **Ultrasound-Based RDN** – Uses ultrasound waves to target nerves.
  - **Alcohol-Based RDN** – Injects alcohol to destroy nerve fibers.
- **Use:**
  - **Resistant Hypertension** (when BP remains high despite multiple drugs).
- **Advantages:**
  - **Long-term BP reduction** without daily medication.
- **FDA Status:** Approved in some regions; ongoing trials for wider acceptance.

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2. Baroreflex Activation Therapy (BAT)

- **Device: "Barostim Neo"** – A **pacemaker-like implant** that stimulates the baroreceptors in the **carotid artery**, helping to lower BP by reducing sympathetic nervous system activity.
- **Use:**
  - **Resistant hypertension** and heart failure.
- **Advantages:**
  - Improves blood pressure without affecting kidney function.
  - Helps **patients intolerant to multiple BP medications**.
- **FDA Approval:** Approved for heart failure; being studied for wider hypertension use.

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3. Carotid Body Ablation

- **Mechanism:** The **carotid body**, a small structure near the carotid artery, senses oxygen levels and can drive hypertension when overactive.
- **Treatment: Minimally invasive removal or deactivation** of the carotid body to lower BP.
- **Use:**
  - **Severe resistant hypertension**.
- **Current Status: Experimental**; clinical trials are ongoing.

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4. Central Arteriovenous (AV) Fistula Therapy

- **Device: ROX Coupler**
- **Mechanism:** Creates a small **AV connection between an artery and vein**, reducing BP by offloading pressure from arteries.
- **Use:**
  - **Resistant hypertension** when medications fail.
- **Status:** Not yet widely available; trials are ongoing.

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5. Gene Therapy & RNA-Based Treatments (Under Research)

- **Approach:**
  - Targets **genes involved in BP regulation**, such as the **angiotensin system**.
  - **RNA-based therapies** (e.g., siRNA) to **suppress hypertension-related proteins**.
- **Potential:** Long-term BP control with **a single treatment** instead of lifelong medication.
- **Current Status: Experimental stage**; may take years for clinical use.

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6. AI-Powered Digital Health & Smart Monitoring

- **Wearable BP Monitors:**
  - **Smartwatches & cuffs** (e.g., Apple Watch, Omron HeartGuide) track BP continuously.
- **AI-Driven Hypertension Management:**
  - Uses **machine learning** to personalize BP treatment.
  - Smartphone apps **remind patients to take meds and adjust lifestyle habits**.

- **Advantages:**
  - **Early detection** of BP fluctuations.
  - **Real-time BP tracking** without frequent clinic visits.

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7. Gut Microbiome Therapy (Emerging Research)

- **Concept:** The gut microbiome influences **blood pressure through gut-derived metabolites**.
- **Potential Therapies:**
  - **Probiotics & prebiotics** to alter gut bacteria.
  - **Fecal microbiota transplantation (FMT)** (being tested in studies).
- **Status:** Still experimental but a promising area of research.

Conclusion: The Future of Hypertension Treatment

✓ **Device-Based Therapies** (Renal Denervation, BAT, AV Fistula) provide new hope for **drug-resistant cases**.

✓ **Gene Therapy & AI-Driven Care** may revolutionize **personalized treatment**.

✓ **Gut Microbiome Research** could introduce **novel non-drug approaches** in the future.