

Submission ID #: 68000

Scriptwriter Name: Sulakshana Karkala

Project Page Link: <https://review.jove.com/account/file-uploader?src=20740048>

## **Title: Improved Home Blood Pressure Control by CT-Guided Ozone-Mediated Renal Denervation for Patients with Resistant Hypertension**

### **Authors and Affiliations:**

**Yizhi Zhang<sup>1,2\*</sup>, Fang Zeng<sup>1\*</sup>, Bin Huang<sup>1\*</sup>, Pingge Tian<sup>1</sup>, Xiwei Chen<sup>1</sup>, Biao Li<sup>1</sup>, Jiashuang Wang<sup>1</sup>, Yihui Huang<sup>1</sup>, Li Li<sup>1</sup>**

**\*These authors contributed equally**

**<sup>1</sup>Department of Cardiology, Guangzhou Red Cross Hospital, Jinan University**

**<sup>2</sup>Department of Cardiology, Shanghai Renji Hospital, Shanghai Jiao Tong University**

### **Corresponding Authors:**

Li Li                                      lilygs@126.com

### **Email Addresses for All Authors:**

Yizhi Zhang	zyzzfklily@126.com
Fang Zeng	gzhchcvdz@163.com
Bin Huang	realgone@foxmail.com
Pingge Tian	1056055170@qq.com
Xiwei Chen	cxw1952@163.com
Biao Li	libiao2025@163.com
Jiashuang Wang	2690668645@qq.com
Yihui Huang	hyh930@sina.com
Li Li	lilygs@126.com

## **Author Questionnaire**

- 1. Microscopy:** Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No.**
  
- 2. Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes, all done.**
  
- 3. Filming location:** Will the filming need to take place in multiple locations? **No.**

### **Current Protocol Length**

Number of Steps: 10

Number of Shots: 24

# Introduction

---

*Videographer: Obtain headshots for all authors available at the filming location.*

**REQUIRED:**

- 1.1. **Li Li:** We are evaluating CT-guided ozone-mediated lumbar or renal denervation as a safe, effective modification of traditional neurolysis for treating patients with resistant hypertension.
  - 1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B.roll:2.10.2*

What are the most recent developments in your field of research?

- 1.2. **Li Li:** Current renal denervation methods are costly and risky. We propose a less invasive, CT-guided ozone-based technique targeting lumbar ganglia for treating resistant hypertension.
  - 1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B.roll:2.10.4*

What advantage does your protocol offer compared to other techniques?

- 1.3. **Li Li:** Compared to catheter-based renal denervation, our technique avoids renal artery access, contrast agents, and specialized catheters; it is simpler, low-cost, and demonstrates a favorable safety profile.
  - 1.3.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

*Videographer: Obtain headshots for all authors available at the filming location.*

**Testimonial Questions:**

*Videographer: Please capture all testimonial shots in a wide-angle format with sufficient headspace, as the final videos will be rendered in a 1:1 aspect ratio. Testimonial statements will be presented live by the authors, sharing their spontaneous perspectives.*

How do you think publishing with JoVE will enhance the visibility and impact of your research?

- 1.4. **Li Li, Director of Cardiology Department, Guangzhou Red Cross Hospital:** Publishing with JoVE uses videos to clearly show the procedure, making it easy for others to understand and replicate. This helps more people learn and adopt the technique, speeding up its spread and development. The video format also attracts attention, broadens the audience, and encourages collaboration.

1.4.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Can you share a specific success story or benefit you've experienced—or expect to experience—after using or publishing with JoVE?

- 1.5. **Li Li, Director of Cardiology Department, Guangzhou Red Cross Hospital:** This is my first time publishing a video article with JoVE. I hope that after our new technique is published, it will attract attention and discussion from colleagues worldwide, increase collaboration opportunities, and contribute to the advancement of international multicenter clinical research.

1.5.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

*Videographer: Please capture the testimonials in both Chinese and English*

**Ethics Title Card**

This research has been approved by the Ethics Board at the Guangzhou Red Cross Hospital

# Protocol

## 2. CT-Guided Peri-Lumbar Sympathetic Ganglion Ozone Injection for Hypertension Treatment

Demonstrator: Li Li

2.1. To begin, help the patient into a prone position while ensuring comfort and stability [1]. Place a metal wire along the midline of the torso, approximately at the T12 to L3 vertebral level [2-TXT]. Use a CT scanner to obtain anteroposterior and lateral images of the lumbar spine [3].

2.1.1. WIDE: Talent assisting the patient in repositioning into a prone position on the CT table.

2.1.2. Talent aligning and taping a metal wire longitudinally over the midline of the patient's back. **TXT: Metal wire acts as reference for deviation from midline of body puncture point** Videographer's NOTE: 2.1.2 (2) is an additional supplementary lens, which can be used as needed.

2.1.3. SCREEN:视频 1.mp4 00:00-00:14

2.2. On the transverse images, identify the left renal artery origin level [1-TXT]. Record the corresponding transverse plane position [2].

2.2.1. SCREEN: SCREEN.mp4 00:00- 00:13 . **TXT: Determine injection target point at anterolateral third of vertebral edge**

2.2.2. SCREEN: SCREEN.mp4 00:13-00:16 .

2.3. On the selected transverse image, locate injection target point A at the anterolateral third of the vertebral side [1]. Then draw a line from point A along the outer lateral border of the left psoas major to the body surface [2].

2.3.1. SCREEN: SCREEN.mp4 00:16-00:23 .

2.3.2. SCREEN: SCREEN.mp4 00:24-00:31.

2.4. Identify the intersection of this line with the body surface as the skin puncture point B [1]. Correlate the metal wire on the body surface with point C [2].

2.4.1. SCREEN: SCREEN.mp4 00:32-00:41.

2.4.2. SCREEN: SCREEN.mp4 00:42- 00:51.

2.5. Measure the length from point A to point B as the needle insertion depth [1]. Then

measure the length of BC as the lateral deviation from the midline [2-TXT].

2.5.1. SCREEN: SCREEN.mp4 00:52

*Video Editor: Please freeze frame here*

2.5.2. SCREEN: SCREEN.mp4 00:58-01:04 **TXT: Angle between AB and BC is puncture angle Q**

2.6. Now adjust the patient bed to the recorded position from the transverse image [1]. Activate the laser positioning line [2]. Mark a line along the projection line A and another along the preplaced metal midline, line B [3-TXT].

2.6.1. Talent adjusting the CT table to align with the saved transverse image coordinates

2.6.2. Talent activating laser lines.

2.6.3. Talent using a marker to draw two intersecting lines on the patient's back. **TXT: Intersection of the lines is the body surface projection point of C**

2.7. Remove the metal wire from the patient's back [1]. On line A, mark point B according to the length of the BC segment [2].

2.7.1. Talent removing the metal wire from the patient's back.

2.7.2. Talent using a ruler to measure and mark point B on line A.

2.8. Next, insert a 21-gauge needle with depth markers at point B, puncturing at the predefined angle and depth [1]. Conduct CT with 2-millimeter slice thickness, 0.4 to 0.8 centimeters around the puncture zone to confirm needle placement [2].

2.8.1. Talent inserting a 21-gauge needle into point B at the marked angle.

2.8.2. SCREEN: SCREEN.mp4 01:26-01:32

2.9. Attach a 10-milliliter syringe to the needle [1]. Aspirate to confirm there is no blood or gas [2].

2.9.1. Talent connecting a 10-milliliter syringe to the needle. **NOTE: 2.9.1 and 2.9.2 are combined.**

2.9.2. Talent checking the syringe for blood or gas.

2.10. Inject 2.5 milliliters of 10 percent ropivacaine [1]. Then use a 20-milliliter syringe to draw 10 milliliters of an oxygen-ozone gas mixture from a medical ozone generator [2-TXT]. Inject it slowly through the needle [3]. Perform a repeat CT scan to confirm ozone distribution [4].

- 2.10.1. Talent injecting 2.5 milliliters of 10 percent ropivacaine into the site.
- 2.10.2. Talent drawing 10 milliliters of gas from an ozone generator. **TXT: Ozone concentration: 40 µg/mL**
- 2.10.3. Talent slowly injecting it. Videographer's NOTE: 2.10.3 (2) is an additional supplementary lens, which can be used as needed.
- 2.10.4. Talent withdrawn the needle.
- 2.10.5. SCREEN: SCREEN.mp4 01:33-01:36



## Results

### 3. Results

- 3.1. The control rate of home systolic blood pressure significantly improved from 60.0% at week 4 to 80.0% at weeks 8 and 12 [1] while the diastolic blood pressure control rate rose from 93.3% at week 4 to 100% at weeks 8 and 12 [2].
  - 3.1.1. LAB MEDIA: Figure 2A. *Video editor: Highlight the light green portion labeled "< 140 mm Hg" at SBP W4 then at SBP W8 and SBP W12*
  - 3.1.2. LAB MEDIA: Figure 2A. *Video editor: Highlight the green portions labeled "< 90 mm Hg" at SBP W4 then at SBP W8 and SBP W12*
- 3.2. Among patients with normal baseline renal function, only 2 failed to achieve systolic blood pressure below 140 millimeters of mercury at 8 and 12 weeks, respectively [1].
  - 3.2.1. LAB MEDIA: Figure 2B. *Video editor: Highlight the red segments representing SBP ≥ 140 mm Hg at W8 and W12.*
- 3.3. Morning systolic and diastolic blood pressures remained significantly higher than others during the 12th week post procedure [1].
  - 3.3.1. LAB MEDIA: Figure 2C. *Video editor: Zoom in on the top-left scatter plot labeled "Morning"*
- 3.4. For patients with normal baseline renal function, the control rates at the four time points were 55.6%, 90%, 77.8%, and 90.0%, respectively [1].
  - 3.4.1. LAB MEDIA: Figure 2D. *Video editor: Sequentially highlight the scatter plots of "Morning", "10 am", "4pm" and "night"*

### Pronunciation Guides:

#### **Prone**

Pronunciation link: <https://www.merriam-webster.com/dictionary/prone>

IPA: /proʊn/

Phonetic Spelling: prohn

#### **Anteroposterior**

Pronunciation link: <https://www.merriam-webster.com/medical/anteroposterior>

IPA: /ˌæn.tə.roʊ.pɑːˈstɪr.i.ər/

Phonetic Spelling: an-tuh-roh-pah-steer-ee-er

#### **Psoas Major**

Pronunciation link: <https://www.merriam-webster.com/medical/psoas%20major>

IPA: /ˈsoʊ.əs ˈmeɪ.dʒər/

Phonetic Spelling: soh-uhs may-jer

❓ **Ozone**

Pronunciation link: <https://www.merriam-webster.com/dictionary/ozone>

IPA: /'oʊ,zoʊn/

Phonetic Spelling: oh-zohn

❓ **Ropivacaine**

Pronunciation link: No confirmed link found

IPA: /roʊ'pivə,keɪn/

Phonetic Spelling: roh-piv-uh-kayn

❓ **Systolic**

Pronunciation link: <https://www.merriam-webster.com/dictionary/systolic>

IPA: /sɪ'stɑːlɪk/

Phonetic Spelling: sis-tah-lik

❓ **Diastolic**

Pronunciation link: <https://www.merriam-webster.com/dictionary/diastolic>

IPA: /daɪ.ə'stɑːlɪk/

Phonetic Spelling: dye-uh-stah-lik

❓ **Renal**

Pronunciation link: <https://www.merriam-webster.com/dictionary/renal>

IPA: /'riː.nəl/

Phonetic Spelling: ree-nuhl

❓ **Vertebral**

Pronunciation link: <https://www.merriam-webster.com/dictionary/vertebral>

IPA: /'vɜːr.tə.brəl/

Phonetic Spelling: vur-tuh-bruhl

❓ **Lumbar**

Pronunciation link: <https://www.merriam-webster.com/dictionary/lumbar>

IPA: /'lʌm.bɑːr/

Phonetic Spelling: lum-bar

❓ **Iliopsoas**

Pronunciation link: <https://www.merriam-webster.com/medical/iliopsoas>

IPA: /ɪˌl.i.oʊ'soʊ.əs/

Phonetic Spelling: il-ee-oh-soh-uhs

❓ **Supine**

Pronunciation link: <https://www.merriam-webster.com/dictionary/supine>

IPA: /'suː.paɪn/

Phonetic Spelling: soo-pine