

Submission ID #: 71008

Scriptwriter Name: Sri Lakshmi Priya

Project Page Link: <https://review.jove.com/account/file-uploader?src=21657488>

**Title: Pulmonary Artery Interventional Thrombectomy Stent System:
Combined Application of Stent and Negative Pressure Aspiration**

Authors and Affiliations:

Xin Liu^{*1,2}, Qian-Hao Guo^{*1}, Feng Wang², Fei Gao¹, Xiang-bo An¹

¹Department of Cardiology, Beijing Anzhen Hospital, Capital Medical University

²Department of Interventional Therapy, First Affiliated Hospital of Dalian Medical University

* These authors contributed equally

Corresponding Authors:

Xiang-bo An	anxiangbo@pku.org.cn
Fei gao	fgaomd@163.com

Email Addresses for All Authors:

Liu Xin	18890381685@163.com
Qian-Hao Guo	2416624877@qq.com
Feng Wang	cjr.wangfeng@vip.163.com
Xiang-bo An	anxiangbo@pku.org.cn
Fei gao	fgaomd@163.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**

- 3. Filming location:** Will the filming need to take place in multiple locations? **NO**

- 4. Testimonials (optional):** Would you be open to filming two short testimonial statements **live during your JoVE shoot**? These will **not appear in your JoVE video** but may be used in JoVE's promotional materials. **NO**

Current Protocol Length

Number of Steps: 17

Number of Shots: 41

Interviews

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

INTRODUCTION:

~~REQUIRED: Summarize your research focus and the main questions it aims to answer.~~

- 1.1. **Xiang-bo An:** Our research focuses on the Tendvia Stent System and addresses how it safely and efficiently removes blood clots during treatment.
 - 1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Describe the research contexts or systems in which this protocol can be applied.~~

- 1.2. **Xiang-bo An:** This protocol is applicable to acute pulmonary embolism, especially high-risk cases with hemodynamic instability or absolute thrombolysis contraindications.
 - 1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

CONCLUSION:

~~What does this protocol allow researchers to study or measure?~~

- 1.3. **Xiang-bo An:** This protocol allows researchers to study rapid thrombus removal and restoration of pulmonary arterial perfusion using combined thrombectomy techniques.
 - 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.

Ethics Title Card

This research has been approved by the Ethics Committee at Beijing Anzhen Hospital
Affiliated to Capital Medical University

Protocol

Videographer: Please always record an audio slate while filming each shot mentioned in the shotlist.

Timecodes are added as provided by authors. The writer has not reviewed the footage for regular (talent) shots"

2. Vascular Access and Sheath Placement

Demonstrator: Xiang-bo An

- 2.1. ~~After performing computed tomography pulmonary angiography or CTPA (CTPA) to confirm the diagnosis of pulmonary embolism, assess the thrombus location and extent [1].~~ **NOTE: Not filmed**
 - 2.1.1. ~~WIDE: Talent preparing the subject for CTPA.~~ *Videographer: Please obtain CU shot as well for this shot.*
 - 2.1.2. ~~Close up of the talent reviewing printed CTPA images on a radiographic film illuminator and pointing to the pulmonary artery thrombus.~~
- 2.2. After assessing the thrombus location using computed tomography pulmonary angiography, identify the puncture site approximately 0.5 to 1 centimeter medial to the femoral artery pulse [1]. **NOTE: VO is edited for the deleted shot**
 - 2.2.1. ~~Close up of the labeled APTmedical Sheath Introducer Set packaging showing 20 French and 35 centimeter specification.~~ **NOTE: Not filmed**
 - 2.2.2. Talent marking the puncture site medial to the femoral artery pulse. **Time stamp: C0001: 0-00: 00: 39: 03**
- 2.3. Advance the Cordis Cashel Introducer Needle into the femoral vein after administering local anesthesia to the patient [1]. Confirm correct intravascular position by observing backflow of venous blood [2] and advance the needle further until cessation of bleeding [3].
 - 2.3.1. Close-up of the Cordis Cashel Introducer Needle entering the skin at the marked point. **C0001: 00: 01: 44: 20-00: 03: 58: 10**
2.3.1.and 2.3.2: 00: 01: 44: 20-00: 03: 58: 10
 - 2.3.2. Extreme close-up of the needle hub showing dark venous blood flowing back into the chamber.
 - 2.3.3. Close-up showing the needle advancing slightly deeper, followed by absence of blood flow at the hub. **C0001: 00: 03: 58: 10-00: 04: 28: 18**

- 2.4. Once the needle sleeve is stabilized, withdraw the Cordis Cashel Introducer Needle [2]. ~~Slowly retract the needle sleeve until blood return is observed within it [3].~~ **NOTE: VO is edited for the deleted shot**
- 2.4.1. ~~Close-up of one hand holding the needle sleeve hub.~~ **NOTE: Not filmed**
- 2.4.2. Close-up of the other hand pulling the needle straight out. **C0001: 00: 05: 53 : 19-00: 06: 09: 00**
- 2.4.3. ~~Extreme close-up of the transparent sleeve showing gradual appearance of venous blood inside.~~ **NOTE: Not filmed**
- 2.5. Advance the guidewire into the femoral vein to a depth of 20 to 30 centimeters [1].
- 2.5.1. Close-up of the guidewire being advanced through the needle sleeve into the femoral vein. **Timestamp: C0001: 00: 06: 09: 00-00: 07: 10: 04**
- 2.6. ~~Apply pressure at the puncture site to maintain hemostasis [1]. Maintain the guidewire position and withdraw the needle sleeve [2].~~ Then, advance a 7 French vascular sheath introducer along the guidewire and insert it into the vessel [3]. **NOTE: VO is edited for the deleted shot**
- 2.6.1. ~~Close-up of the operator applying gentle pressure at the puncture site~~
- 2.6.2. ~~Close-up of withdrawing the needle sleeve while the guidewire remains in place.~~ **NOTE: Not filmed**
- 2.6.3. Close-up of the 7 French sheath introducer being threaded over the guidewire and pushed into the vessel. **C0001: 00: 13: 08: 09-00: 13: 32: 15**
- 2.7. After advancing the vascular sheath introducer to the appropriate intravascular position, withdraw the guidewire [1]. **NOTE: VO is edited for the deleted shot**
- 2.7.1. ~~Close-up of the sheath introducer being advanced further until the desired intravascular position is achieved.~~ **NOTE: Not filmed**
- 2.7.2. ~~Close-up of one hand gripping and securing the sheath.~~
- 2.7.3. Close-up showing the inner dilator and guidewire being pulled out together. **C0001: 00: 09: 37: 10-00: 13: 38: 16**

3. Pulmonary Artery Angiography

Shots labeled as SCREEN are filmed by the videographer

- 3.1. Once the vascular access is established, inject 3000 units of heparin and add 1000 units every additional hour of surgery [1].
- 3.1.1. Talent injecting heparin. **C0001: 00: 14: 51: 00-00: 15: 00: 00**

3.2. Under continuous X-ray fluoroscopic guidance, advance the guidewire through the sheath [1]. Navigate it through the inferior vena cava [2], right atrium [3], and right ventricle to reach the main pulmonary artery [4].

3.2.1. SCREEN: Show the guidewire traversing through the sheath under the X-ray fluoroscopy. C0001: 00: 16: 53: 03-00: 18: 07: 01

Videographer: Please record the computer screen for the shots labeled as SCREEN as back-up

3.2.2. SCREEN: Show the guidewire traversing the inferior vena cava under X-ray fluoroscopy.

3.2.3. SCREEN: Show the guidewire traversing the right atrium under X-ray fluoroscopy.

3.2.4. SCREEN: Show the guidewire passing through the right ventricle and reaching the main pulmonary artery.

3.3. Advance a 5 French angiography catheter over the guidewire into the pulmonary artery [1].

3.3.1. SCREEN: Show the angiography catheter advancing over the guidewire into the pulmonary artery. C0001: 00: 21: 36: 11-00: 22: 44: 06

3.4. To perform pulmonary angiography, inject 30 milliliters of contrast agent for both the left and right pulmonary arteries at a rate of 15 milliliters per second and a pressure of 600 pounds per square inch [1]. ~~Confirm the exact location and morphology of the thrombus to provide a roadmap for the subsequent thrombectomy procedure [3].~~

NOTE: VO is edited for the deleted shot

~~3.4.1. Close-up shot of contrast agent being injected through the catheter.~~ **NOTE: Not filmed**

3.4.2. Close-up of the contrast injection system displaying the programmed injection parameters of 15 milliliters per second and 600 pounds per square inch.

C0001: 00: 27: 51: 15-00: 28: 12: 10

~~3.4.3. SCREEN: Show the close-up of thrombus.~~ **NOTE: Not filmed**

4. Combined Stent-retriever and Aspiration Thrombectomy

4.1. After advancing a Boston Scientific Amplatz Super Stiff guidewire across the thrombus, track a 20 French aspiration catheter to the pulmonary artery [1-TXT]. Position the tip of the catheter adjacent to the thrombus [2]. **NOTE: VO is edited for the deleted shot**

~~4.1.1. Talent advancing the guidewire across the thrombus.~~ **NOTE: Not filmed**

4.1.2. SCREEN: Show the aspiration catheter advancing over the guidewire into the pulmonary artery. **XT: Boston Scientific Amplatz Super Stiff guidewire: 0.035-inch x 260-cm** C0002: 00: 27: 11: 12-00: 27: 44: 00

- 4.1.3. SCREEN: Show the catheter tip being positioned adjacent to the thrombus.
- 4.2. Once the catheter core is removed, advance the thrombectomy stent through the aspiration catheter over the guidewire until its distal end is positioned beyond the thrombus and allow the self-expanding mesh basket to deploy fully within the thrombus [1]. NOTE: VO is edited for the deleted shot
- 4.2.1. ~~Talent removing the catheter core.~~ NOTE: Not filmed
- 4.2.2. SCREEN: Show the thrombectomy stent advancing through the aspiration catheter over the guidewire beyond the thrombus. C0002: 00: 31: 14: 23-00: 31: 55: 00
- 4.3. ~~Retract the delivery sheath slowly and steadily [1] to allow the self-expanding mesh basket to deploy fully within the thrombus [2].~~
- 4.3.1. ~~SCREEN: Show the delivery sheath being retracted~~
- 4.3.2. ~~SCREEN: Show the mesh basket being expanded within the thrombus.~~
- 4.4. Allow the stent to dwell for approximately 90 seconds to engage the clot and then gently retract the entire thrombectomy device [1] while rotating the control switch to maintain optimal aspiration [2-TXT]. NOTE: VO is edited for the deleted shot
- 4.4.1. ~~Shot of the device placed in position for a few seconds.~~
- 4.4.2. ~~Talent activating the aspiration device.~~ NOTE: Not filmed
- 4.4.3. SCREEN: Show the thrombectomy device being retracted. C0002: 00: 32: 42 : 18-00: 33: 31: 12
- 4.4.4. SCREEN: Close-up of the control switch being rotated. TXT: Refer to the text for thrombus removal and extraction
- 4.5. ~~Capture the thrombus with the mesh basket [1] and draw it into the lumen of the aspiration catheter under active suction [2].~~ NOTE: Not filmed. The information is added as an onscreen text in the previous step
- 4.5.1. ~~SCREEN: Show the mesh basket capturing the thrombus.~~
- 4.5.2. ~~SCREEN: Show the thrombus being drawn into the aspiration catheter under suction.~~
- 4.6. ~~Evacuate the thrombus from the body through continuous negative pressure aspiration [1]. Combine this with mechanical traction during device withdrawal [2].~~
- 4.6.1. ~~SCREEN: Show the thrombus being removed through aspiration.~~
- 4.6.2. ~~SCREEN: Show the device being withdrawn with mechanical traction.~~

Results

5. Results

- 5.1. Preoperatively, the main pulmonary artery contained an extensive bridging thrombus [1] with extension into the left pulmonary artery [2], as well as the right pulmonary artery and its branches [3].
 - 5.1.1. LAB MEDIA: Figure 4. *Video editor: Highlight the darker area that the arrow is pointing to, labeled thrombus.*
 - 5.1.2. LAB MEDIA: Figure 4. *Video editor: Highlight the left part of the darker area that the arrow is pointing to, labeled thrombus.*
 - 5.1.3. LAB MEDIA: Figure 5. *Video editor: Highlight the tubes labeled as aspiration catheter and the thrombectomy stent along their full visible path*
- 5.2. The proximal segments of the bilateral pulmonary arteries were mildly dilated [1], indicating significant thrombus burden and impaired pulmonary blood flow [2].
 - 5.2.1. LAB MEDIA: Figure 4. *Video editor: In the central white inverted Y-shaped area, circle and highlight the upper parts of the left and right branches just after the split.*
 - 5.2.2. LAB MEDIA: Figure 4.
- 5.3. Postoperatively, bilateral pulmonary arterial trees were well-opacified with complete resolution of the filling defects [1] and a restored normal luminal diameter in the main pulmonary arteries [2].
 - 5.3.1. LAB MEDIA: Figure 6. *Video editor: Emphasize the white middle region in inverted Y shape*
 - 5.3.2. LAB MEDIA: Figure 6. *Video editor: In the central inverted Y-shaped area, circle and highlight the upper parts of the left and right branches just after the split.*
- 5.4. The absence of filling defects [1] and uniform contrast distribution indicated restored pulmonary blood flow [2].
 - 5.4.1. LAB MEDIA: Figure 7. *Video editor: In both panels, emphasize the arrow, label "Resolved Filling Defect" and the vessel segment exactly where the arrow points.*
 - 5.4.2. LAB MEDIA: Figure 7. *Video editor: In both panels, highlight the large blood vessels and their smaller branches that appear evenly filled with the gray dye*

1. Thrombus
Pronunciation link: <https://www.merriam-webster.com/dictionary/thrombus>
IPA: /'θrɑ:m.bəs/
Phonetic Spelling: thrahm·buhs
2. Computed tomography
Pronunciation link: <https://www.merriam-webster.com/dictionary/tomography>
IPA: /kəm'pju:.tɪd tə'mɑ:.grə.fi/
Phonetic Spelling: kuhm·pyoo·tid tuh·mog·ruh·fee
3. Pulmonary angiography
Pronunciation link: <https://www.merriam-webster.com/dictionary/angiography>
IPA: /'pʊl.mə,ner.i ,æn.dʒi'ɑ:.grə.fi/
Phonetic Spelling: pull·muh·nair·ee an·jee·og·ruh·fee
4. Femoral
Pronunciation link: <https://www.merriam-webster.com/dictionary/femoral>
IPA: /'fem.ə.əl/
Phonetic Spelling: fem·er·uhl
5. Intravascular
Pronunciation link: <https://www.merriam-webster.com/dictionary/intravascular>
IPA: /,ɪn.trə'væs.kjə.lə/
Phonetic Spelling: in·truh·vas·kyuh·ler
6. Hemostasis
Pronunciation link: <https://www.merriam-webster.com/dictionary/hemostasis>
IPA: /,hi:.mʊ'steɪ.sɪs/
Phonetic Spelling: hee·moh·stay·sis
7. Vascular
Pronunciation link: <https://www.merriam-webster.com/dictionary/vascular>
IPA: /'væs.kjə.lə/
Phonetic Spelling: vas·kyuh·ler
8. Heparin
Pronunciation link: <https://www.merriam-webster.com/dictionary/heparin>
IPA: /'hep.ə.rɪn/
Phonetic Spelling: hep·uh·rin
9. Fluoroscopic
Pronunciation link: <https://www.merriam-webster.com/dictionary/fluoroscopic>
IPA: /,flʊr.ə'skɑ:.pɪk/
Phonetic Spelling: floor·uh·skop·ik
10. Inferior vena cava
Pronunciation link: <https://www.merriam-webster.com/dictionary/inferior%20vena%20cava>
IPA: /ɪn'fɪr.i.ə ,vi:.nə 'keɪ.və/
Phonetic Spelling: in·feer·ee·er vee·nuh kay·vuh
11. Atrium
Pronunciation link: <https://www.merriam-webster.com/dictionary/atrium>

IPA: /'eɪ.tri.əm/

Phonetic Spelling: ay·tree·uhm

12. Ventricle

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

IPA: /'ven.trɪ.kəl/

Phonetic Spelling: ven·trih·kuhl

13. Catheter

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

IPA: /'kæθ.ə.t̬ə/

Phonetic Spelling: kath·uh·ter

14. Morphology

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

IPA: /mɔːr'fɑː.lə.dʒi/

Phonetic Spelling: mor·fol·uh·jee

15. Thrombectomy

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

IPA: /θrɑːm'bek.tə.mi/

Phonetic Spelling: thrahm·bek·tuh·mee

16. Aspiration

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

IPA: /,æs.pə'reɪ.ʃən/

Phonetic Spelling: as·puh·ray·shuhn

17. Distal

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

IPA: /'dɪs.təl/

Phonetic Spelling: dis·tuhl

18. Lumen

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

IPA: /'luː.mən/

Phonetic Spelling: loo·muhn

19. Proximal

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

IPA: /'prɑːk.sə.məl/

Phonetic Spelling: prok·suh·muhl

20. Bilateral

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

IPA: /baɪ'læt̬.ə.əl/

Phonetic Spelling: bye·lat·er·uhl

21. Opacified

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

IPA: /oʊ'pæs.ə'faɪd/

Phonetic Spelling: oh·pas·uh·fyd

22. Luminal

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

IPA: /'lu:.mə.nəl/

Phonetic Spelling: loo·muh·nuhl