Trans-radial Angiography-guided Femoral Puncture for TAVR in an Extremely Obese Patient with Critical Aortic Stenosis and Deeply Buried Femoral Arteries – A Case Report

Yi-Kai Huang[1], Hsu-Chung Lo, MD[2], Kae-Woei Liang, MD, PhD[1,2], Chu-Leng Yu, MD[2], Wen-Lieng Lee, MD, PhD[1,2,3]

[1]*Department of Medicine, National Yang-Ming Chiao-Tung University School of Medicine, Taipei, Taiwan*
[2]*Cardiovascular Center, Taichung Veterans General Hospital, Taichung, Taiwan*
[3]*Department of Medicine, National Chung-Hsing University College of Medicine, Taichung, Taiwan*

Introduction

Nowadays, trans-catheter aortic-valve replacement (TAVR) is a widely-used standard therapy for critical aortic stenosis, especially for patients at high or very high risk during open heart surgery.[1] The procedures of TAVR have been continually modified and have become standardized in recent years. Vascular access remains a fundamental and indispensable part of the procedure. Several alternative approaches have been used in clinical practice, including trans-apical, trans-axillary, trans-subclavian, trans-carotid, trans-caval and direct aortic ones, for patients with no suitable femoral routes.[2-5] However, all of the above have their specific limitations[3-7] and the trans-femoral route remains the least invasive approach of choice, with the least complications and best accessibility for complication management.[1]

Ultrasound- or palpation-guided puncture of the femoral artery at the femoral head level is the standard practice.[8] However, the femoral artery may be deeply buried and impalpable or even sonographically invisible in patients with morbid obesity. How to obtain femoral access under such circumstances remains a major issue of clinical importance. Herein, we reported one such case in whom the femoral access was successfully obtained in a trans-radial angiography-guided manner. TAVR procedures were subsequently carried out smoothly following standard practice and the percutaneous wound was closed at the end of the procedure without any complications despite the morbid obesity.

Case

The patient was a 67-year-old hypertensive Nauruan male who presented with acute chest pain in October 2021 for which IV thrombolytic therapy was given for acute anterior ST-elevation myocardial infarction. Due to subsequent intermittent anterior chest tightness and heart failure with left ventricular dysfunction, he was ultimately referred to our institute in Taiwan as an international medical service case from The Republic of Nauru for revascularization therapy in

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Address for correspondence: Wen-Lieng Lee, MD, PhD
Cardiovascular Center, Taichung Veterans General Hospital; 1650, Taiwan Boulevard Sect. 4, Taichung 40705, Taiwan
Tel: +886-9-28310103; E-mail: wenlieng.lee@gmail.com

December of 2021. The laboratory tests showed serum creatinine of 1.3 mg/dl, hemoglobin A1c of 5.9 mg/l, hemoglobin of 13.2 mg/dl, total cholesterol of 158 mg/dl and low-density-lipoprotein cholesterol of 99 mg/dl. Upon physical examination, his vital signs were stable and he was conscious and lucid. He was 168 cm in height and 135 kg in weight, and had to use a wheelchair for transportation due to morbid obesity and dyspnea upon minimal exertion. Echocardiography showed a left-ventricular ejection fraction of 24% and generalized hypokinesia of the left ventricle. Critical aortic stenosis with calculated aortic valve area of 0.9 cm^2 was subsequently documented. Chest x-ray revealed enlarged cardiac shadow and prominent bilateral hila.

The coronary angiogram was done but the images were blurred due to morbid obesity, especially on lateral projections. It disclosed severe atherosclerotic changes over the coronary tree with 60% stenosis at the left main bifurcation, 90% stenosis at the left anterior descending artery (LAD) ostium, stumpless chronic-total-occlusion over the distal LAD (Figure 1, Panels A and B), 80% eccentric segmental stenosis over the first obtuse marginal branch (OM1), 75% stenosis over the posterior descending artery (PDA) of the right coronary artery (RCA), and discrete 99% stenosis over the proximal RCA. During percutaneous coronary intervention (PCI), the distal LAD was successfully opened up and stented. The OM1 and RCA-PDA were also successfully treated with drug-eluting stents. The distal LM to proximal LAD was stented under intravascular ultrasound guidance. The patient tolerated the whole procedure without complications and recovered well. The dyspnea improved significantly but not fully. After PCI, pre-TAVR multidetector computed tomography (MDCT) was performed and disclosed calcifications over the thoracic and abdominal aorta, as well as the bilateral iliac and femoral arteries which were large enough to accommodate a TAVR catheter.

Two months after the PCI, he was re-admitted for TAVR treatment under general anesthesia. Owing to the morbid obesity, the bilateral femoral arteries could not be palpated at all, and the ultrasound failed to identify the femoral arteries as they were deeply buried in fat tissue. Trying to perform calcification-guided femoral puncture under fluoroscopy proved unsuccessful due to a lack of visible calcification. Finally, it was determined that trans-radial angiography-guided femoral puncture could be worth an attempt. Therefore, the left radial artery was cannulated and a 6F sheath was introduced. After advancing a 6F diagnostic JR 4 catheter all the way down the right iliac artery, the right femoral artery could be visualized by contrast medium and femoral puncture was easily made by the Micro-puncture introducer set (Cook Medical, IN, US) at the femoral head level (Figure 1, Panel C), followed by sheath placement. Temporary RV pacing was made via the left femoral vein, a 6F pigtail catheter was introduced via the left radial artery and the ascending aortography was made. After heparin was given, the right femoral sheath was exchanged for a 16F expandable E-sheath introducer set (Edwards Lifesciences, CA, US) and a 0.035" wire was passed through the aortic valve into the left ventricle. This was subsequently exchanged with a 260 cm-long 0.035'' pre-shaped extra-stiff Confida wire (Medtronik, CA, US) through another pig-tail catheter. Then a 29 mm Sapien 3 trans-catheter heart valve (THV; Edwards Lifesciences, CA) was introduced through the expandable sheath, properly positioned at the aortic annulus and deployed precisely (Figure 1, Panel D). Angiographic and trans-esophageal echocardiographic checks of the prosthetic valve were done and confirmed normal prosthetic function without any complication. The expandable sheath was removed after a 0.035'' wire was introduced through the left femoral access and externalized at the right femoral access for safety assurance. Right femoral closure using two Perclose Proglides (Abbott Vascular, CA, US) was successfully achieved with complete hemostasis and no vessel injury. The patient recovered very well from the procedure with

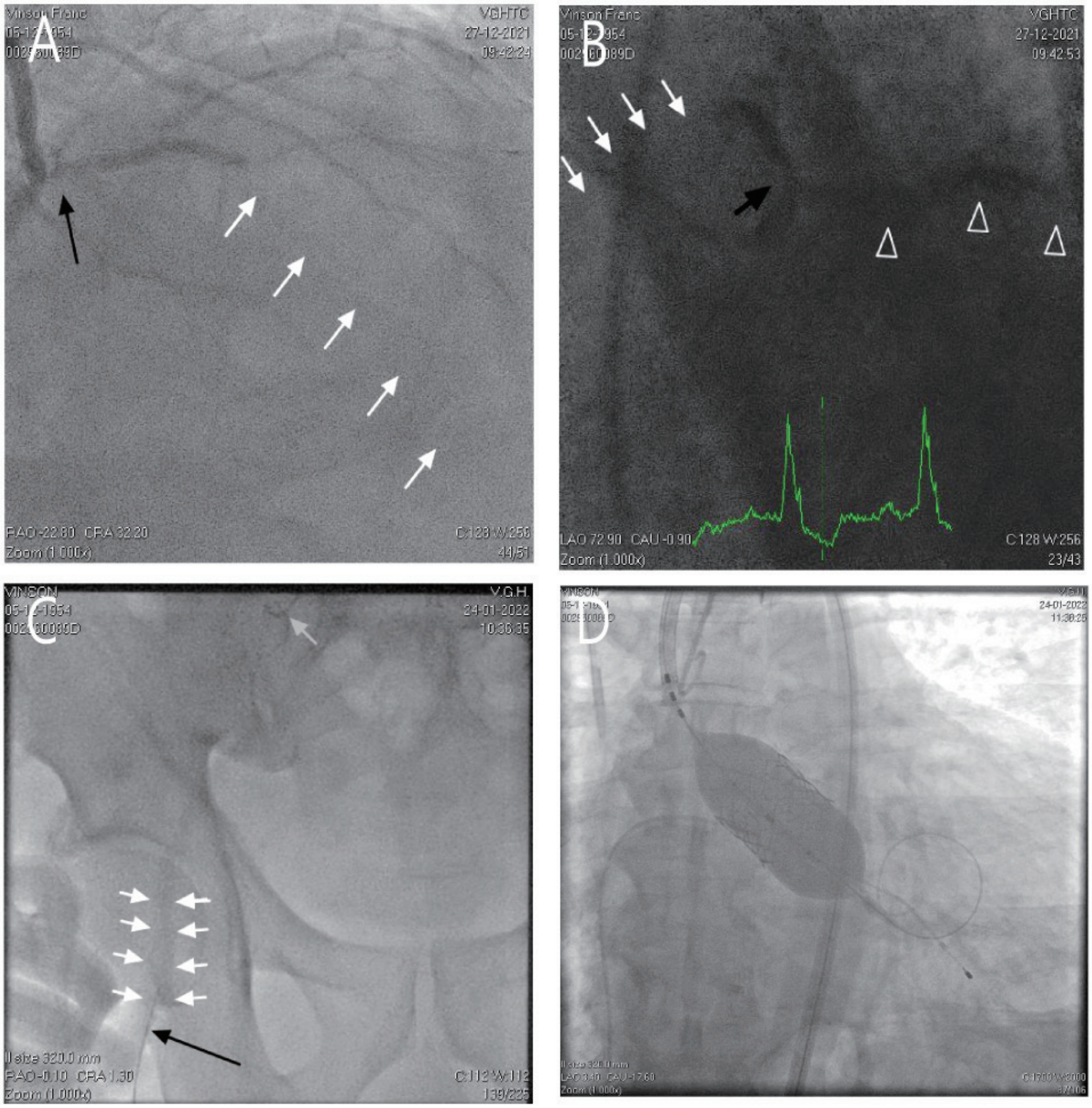

Figure 1. Panel A: The ostial LAD was 90% stenotic (black arrow) and the distal LAD was chronically and totally occluded without stump (white arrows; RAO cranial view); Panel B: Due to morbid obesity, both the LAD and LCX were obscured and visualization in the LAO caudal view was poor. The ostial LAD was critically stenotic (black arrow) and the distal LAD was chronically and totally occluded (white arrows). The entire LCX was hard to visualize (white arrowheads); Panel C: Trans-femoral access was guided by trans-radial femoral angiography (white arrows) after placing a 6F diagnostic JR catheter in the common iliac artery (single white arrow) and was successfully obtained using a micro-puncture set (black arrow); Panel D: TAVR was successfully performed using a 29mm Sapien 3 THV through pre-shaped extra-stiff wire, supported by trans-femoral vein temporary right ventricular pacing.

Abbreviations: LAD: left anterior descending artery; LAO: left anterior oblique; LCX: left circumflex artery; RCA: right coronary artery; RAO: right anterior oblique; TAVR: trans-catheter aortic-valve replacement; THV: trans-catheter heart valve no complications and was discharged from the hospital after 5 days. After having been treated for both coronary and aortic diseases, he returned to his home country extremely satisfied.

Discussion

TAVR has become the predominant treatment for patients with critical aortic stenosis and high to extremely high surgical risks.[1,5] The transfemoral approach is the preferred route in the majority of TAVR procedures, especially within the context of the current TAVR delivery system.[9] Although most inoperable patients can be treated with TAVR through trans-femoral access, it has been reported that up to 1/3 of eligible patients may not be candidates for this approach.[9] Contraindications to the trans-femoral approach include unsuitable ilio-femoral vessel size and anatomy, severe atherosclerosis and significant vessel tortuosity. Therefore, alternative vascular routes have emerged.[2,4,9] Nowadays, the use of trans-subclavian and trans-carotid approaches has expanded rapidly,[2,9] mainly due to the ease of accessibility and the avoidance of thoracotomy. Improvements in technique and refinement of the devices also play an important role. Trans-carotid TAVR may offer several advantages over trans-thoracic TAVR, including lower rates of atrial fibrillation and major bleeding, reduced hospital stay and lower 30-day mortality.[3,6] However, there have been some signs of increased cerebrovascular accidents among patients undergoing trans-carotid and trans-subclavian TAVR.[3,4,7] In patients who are unsuitable for trans-carotid and trans-subclavian access, the trans-caval approach remains a viable option.[10] In terms of clinical outcomes and vascular complications, the transfemoral approach has been associated with better clinical outcomes and the least complications,[1,8,9] whereas the transaortic and transapical routes have been linked to worse outcomes with increased cardiac mortality.[4,7]

Despite the many merits of the trans-femoral approach, access by this vessel has been an issue in patients with morbid obesity when the vessel was not palpable or even sonographically invisible. Complete hemostasis after the procedure could be another issue in these patients, especially if carried out by manual hemostasis. In this reported case, we devised a novel approach, i.e., trans-radial angiography-guided femoral puncture. Using our approach, femoral puncture at the femoral head level (common femoral artery site) was easily and safely made under angiography guidance, and the risk of open-wound vessel cut-down or blind puncture was avoided. In non-angiography-guided cases, the pre-TAVR MDCT can be utilized to determine the femoral puncture level, supported by fluoroscopy. The risks of alternative vessel approaches can be avoided too. Using the familiar Perclose system for wound closure also averts the need for open closure, and the wound complications associated with it in such morbidly obese patients. However, perclosure failure could lead to deep wound bleeding that could be difficult to check in such a case. That was the reason why we externalized the 0.035" wire through the right femoral access in order to safeguard the success of perclosure and achieve solid hemostasis.

Learning Points

1. Trans-femoral vascular access remains the approach of choice for TAVR in patients with critical aortic stenosis but this vessel could be deeply buried in soft tissue and extremely difficult to locate in cases of morbid obesity. Failure to achieve complete hemostasis could also be an issue.
2. While there are several alternative vascular approaches for TAVR, they all have their inherent limitations and are equally difficult and dangerous to perform in extremely morbid obesity.
3. Under such circumstances, trans-radial angiography-guided femoral puncture at the ideal femoral head level (also as indicated after

pre-TAVI MDCT), followed by perclosure at the end of the procedure, could be an ideal option that is efficient and safe and offers quick recovery.

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none

Declaration of Conflict of Interest

All authors declare no conflict of interest.

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Ethics Approval and Consent to participate

Not applicable.

Abbreviations

LAD	left anterior descending artery
LCX	left circumflex artery
MDCT	multidetector computed tomography
PCI	percutaneous coronary intervention
RCA	right coronary artery
TAVR	trans-catheter aortic-valve replacement
THV	trans-catheter heart valve

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